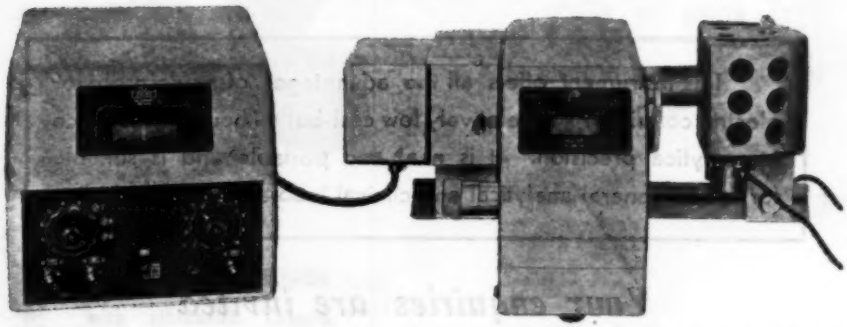
REGD. No. M. 2799

# Current Science

Vol. 24, No. 9 SEPTEMBER 1955 Pages 289-324


## ZEISS SPECTROPHOTOMETER

**Mains-operated Model PMQ II**



For measurements from 200 mμ in the ultraviolet to 1000 mμ in near infrared region with high spectral resolution. Write for illustrated literature.

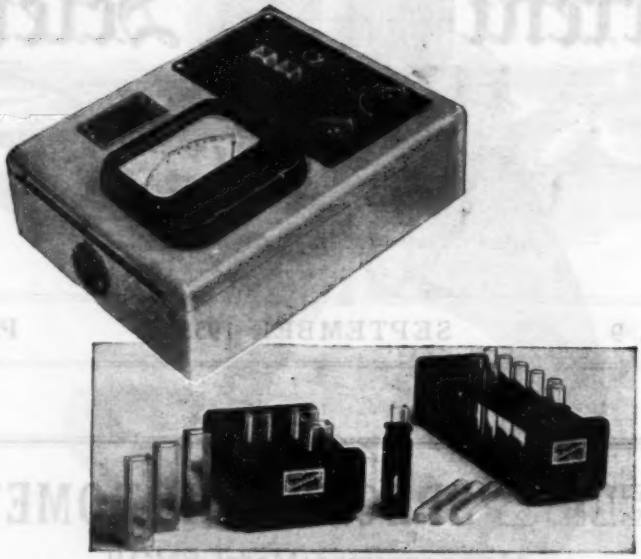
*Sole Agents:*

ADAIR, DUTT & CO. (India), LTD.

CALCUTTA NEW DELHI BOMBAY MADRAS

Gallenkamp
REG'D.

# PHOTOELECTRIC COLORIMETER



This instrument offers all the advantages of modern photo-electric colorimetry at relatively low cost but without any sacrifice in analytical precision. It is neat and portable and is suitable for use in general analytical and clinical laboratories.

*Your enquiries are invited*

*Accredited Agents for India:*

MARTIN & HARRIS Ltd.

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

# 'WILD'

## HEERBRUGG

WILD Microscope M10BK with attachable Camera and Wild Low Voltage Lamp with Transformer.

WILD HEERBRUGG

*The Microscope of Choice for all Exacting Work !*

* High precision achieved by modern equipments

* Outstanding optical performance

* Extensive interchangeability of parts

* Extreme convenience of operation

* Modern overall design

*Sole Agents:*

**RAJ-DER-KAR & CO.**

COMMISSARIAT BUILDING, HORNBY ROAD
BOMBAY-1

Telephone: 27304 Telegram: TECHLAB

## ORGANIC CHEMISTRY

*8th Revised Edition*

By P. B. SARKAR, D.Sc., F.N.I.

*Director of Technological Research*
*Indian Central Jute Committee*

First Published 1942 — 8th Ed. 1955
vi+490 P. 8½×5½ — Cloth Bound — Rs. 8

"Undoubtedly the best book on the subject."

I. R. GAMBHIR, M.Sc.
*Prof. of Chemistry, Meerut College, Meerut*

## INTERMEDIATE PHYSICS

By N. N. BASU & J. CHATTERJEE

*15th Edition, 1954. In Two Vols. D/D Size*

Lucid exposition, up-to-date information, numerous worked out examples, all-India examination questions, and neat diagrams are the features of this standard work. Popular all over India. Covers all-India University syllabuses.

Rs. 6 *Each Vol.*

## PRACTICAL CHEMISTRY

*For B.Sc. Students*

By B. K. GOSWAMI, M.Sc.
*Prof. of Chemistry, Midnapur College*

The book covers the analytical portion meant for B.Sc. students (Pass & Hons.) of Indian Universities.

Rs. 5

## INORGANIC CHEMISTRY

*For Intermediate Students of Indian Universities*

By P. K. DUTT, M.Sc.
*Prof. of Chemistry, Hoogli Govt. College*

*4th Revised Edition, 1954, 635 pp.* Rs. 6

A complete course, in lucid style, with up-to-date information. The only book which will cover the all-India University syllabus.

## A TEXT-BOOK OF HEAT

*(for Junior Students)*

*8th Revised and Enlarged Edition*

By Dr. M. N. SAHA, F.R.S.
*Director, Indian Association for the Cultivation of Science, Calcutta*

AND

Dr. B. N. SRIVASTAVA, D.Sc.
*Prof. of Physics, Indian Association for the Cultivation of Science, Calcutta*

It commands a monopoly sale in India and Pakistan as the best book on the subject and fully covers the syllabuses of Indian and Pakistan Universities. Cloth Bound, Rs. 9

## ELEMENTARY PHYSICAL CHEMISTRY

*9th Revised Edition, 1953*

By Dr. SANTI RANJAN PALIT
M.Sc. (*Gold Medalist*), P.R.S. (*Cal.*)
D.Sc., F.R.I.C. (*Lond.*)
*Prof. of Physical Chemistry, Indian Association for the Cultivation of Science Calcutta*

The book has been thoroughly revised and made up to date. The present edition meets the requirements of Degree (Pass) students of all Indian and Pakistan Universities.

Price Rs. 6-4

**Used all over India as the only reliable Text**

## TEXT-BOOK OF INORGANIC CHEMISTRY

By P. RAY, M.A., F.N.I.
*Formerly Palit Prof. of Chemistry*
*University College of Science, Calcutta*

An authoritative text on the subject covering the B.Sc. Syllabuses of Indian and Pakistan Universities. The book is expected to excel all other publications and remove a longfelt want. Combined Vol. Rs. 11

Vol. I. Rs. 6 — Vol. II. Rs. 6

# H. CHATTERJEE & CO., LTD.

19, SHYAMA CHARAN DE STREET, CALCUTTA 12

**Tata Institute of Fundamental Research**
**Appollo Pier Road**
**BOMBAY 1**

APPLICATIONS are invited for one post of RESEARCH FELLOW in Inorganic Chemistry in the grade Rs. 400-40-600 plus such allowances as are admissible to Central Government employees stationed in Bombay. A higher starting salary in the grade may be given to a candidate with exceptional ability and experience. The duties of a Research Fellow include, independent research and guiding Research Assistants.

**Qualifications:** A doctor's degree in Inorganic Chemistry with research experience and published research work of acknowledged merit. Experience in the field of tracer chemistry and geochemical problems desirable.

Applications stating full name and address, age, qualifications and details of published research work should reach the Registrar, not later than October 20, 1955.

*You can be sure of the results only when you are using Quickfit and Quartz Apparatus*

1. **"QUICKFIT"** Semi-Micro Organic Preparation Apparatus.
2. **"QUICKFIT"** Interchangeable Ground Glass Assemblies for Distillation, Fractionation, etc.
3. **"QUICKFIT"** High Vacuum Stopcocks.
4. **"QUICKFIT"** Spherical Joints.
5. Laboratory Sieves B.S.S. & A.S.T.M. Manufactured by Endecotts Filters Ltd.
6. Sartorius Balances.
7. 'Lumetron' Fluorescence Meters, Colorimeters and pH Meters.
8. Hellige Duboscq Colorimeters.
9. Redwood Viscometers.
10. Pyrex Glassware, Porcelainware and Silicaware.

*Available from stock:*

**UNION SCIENTIFIC SYNDICATE**
**52-58, Babu Genu Road, P.O. Box No. 2484**
**BOMBAY 2**

STANDARD

**RESISTANCE BOXES**

SINGLE AND MULTIPLE DIALS
MINALPHA COILS
0·1% ACCURACY

SELF-CLEANING CONTACTS
OF SPECIAL MATERIALS
NEGLIGIBLE CONTACT RESISTANCE

*Made by*

**THE STANDARD SCIENTIFIC INSTRUMENTS CO.**
**115, BRODIES ROAD, MADRAS 28**

*Varying Temperature*

**MATERIAL TESTING CABINET**

Range: −15° C to + 100° C
Sensitivity: ± ·5° C

*Also*

**HIGH PRECISION THERMOSTAT BATHS**

(i) Range: ambient to 100° C
Sensitivity: ± 0·005° C

(ii) Range: +5° C to +100° C
Sensitivity: ± ·1° C

*Manufactured by:*

**UDAY SCIENTIFIC INDUSTRIES**
**5, Bhabanath Sen St.**
**CALCUTTA 4**

*For*

Autoclaves and Sterilizers
Bacteriological Incubators
Color Indicating Apparatus
Chill Baths
Hot Plates
Kjeldahl Digestion Apparatus
Kahn Test Apparatus
Constant Temperature Ovens

Egg Hatching Incubators
Electrolytic Analysis Apparatus
Multiple Unit Incubators
Memory Testing Apparatus
Precision Thermostat Bath
Humidity-*cum*-Temperature Controlled Ovens
Wide Range Incubators

**and in general all plants and automatic controlling equipments of any type required for Education, Industry and Research**

*Please Consult*

BIOLOGICAL SUPPLY CONCERN LTD.

'BIOSCO'

14, HARE STREET :: CALCUTTA 1

METRO'S Contribution

In the Field of
NEUTRAL GLASS INDUSTRY

- TRANSFUSION BOTTLES
- VACCINE PHIALS
- OUNCE BOTTLES
- GLASS TUBINGS & RODS
- REAGENT BOTTLES
- AMPOULES OF ALL DESCRIPTIONS

METRO GLASS WORKS LIMITED

20, NETAJI SUBHAS ROAD (1ST FLOOR)
CALCUTTA 1

GRAM : NEUTRAVIAL PHONE : 22-3331

INDEX SIGCOL

*Do you know?*

Sigcol Index combines three in one? Behind every Index beaker and flask you can see long experience backed by scientific research. Index is a symbol of guarantee for laboratory work. It is

- Resistant to chemical reagents.
- Resistant to mechanical shocks.
- Resistant to heat (coefficient of expansion is only $3 \cdot 4 \times 10^{-6}$).

*Sole Distributors :*

GHARPURE & CO

P-36, Royal Exchange Place Extn.
Calcutta 1

*Just published:* Volume 24

ANNUAL REVIEW OF

# BIOCHEMISTRY

**Editors:** J. MURRAY LUCK, H. S. LORING, G. MACKINNEY.

**Editorial Committee:** H. J. ALMQUIST, H. J. DEUEL, JR., W. Z. HASSID, B. L. HORECKER, T. H. JUKES, J. M. LUCK.

CONTENTS

Biological Oxidations, *D. E. Green and H. Beinert.*
Nonoxidative, Nonproteolytic Enzymes, *B. Axelrod.*
Proteolytic Enzymes, *G. W. Schwert.*
Chemistry of Carbohydrates, *J. K. N. Jones.*
Chemistry of Phosphatides, *E. Baer.*
Metabolism of Complex Lipides, *D. B. Zilversmit.*
Chemistry of Proteins, Peptides and Amino Acids, *A. G. Ogston.*
Carbohydrates Metabolism, *B. L. Horecker and A. H. Mehler.*
Metabolism of Amino Acids and Proteins, *G. Ehrensvärd.*
Nucleic Acids, *D. M. Brown and A. R. Todd.*
Lipid Metabolism, *F. Lynen.*
Water-Soluble Vitamins, Part I, *G. Briggs and F. Daft.*
Water-Soluble Vitamins, Part II, *R. Fried and H. A. Lardy.*
Water-Soluble Vitamins, Part III, *B. Johnson.*
Fat-Soluble Vitamins, *P. D. Boyer.*
Carotenoids, *T. W. Goodwin.*
Nutrition, *J. F. Brock.*
Biochemistry of Steroid Hormones, *S. Roberts and C. M. Szego.*
Biochemistry of Antibiotics, *S. B. Binkley.*
Clinical Applications of Biochemistry, *O. Bodansky.*
The Biochemistry of Cancer, *A. Haddow.*

**each volume, $7.50 postpaid** **805 pages**

*Published in September 1955:* Volume 6

Annual Review of PHYSICAL CHEMISTRY

**Editors:** G. K. ROLLEFSON, R. E. POWELL; **Editorial Committee:** B. L. CRAWFORD, JR., G. E. KIMBALL, J. G. KIRKWOOD, F. A. LONG, G. K. ROLLEFSON, J. W. WILLIAMS

**each volume, $7.50 postpaid** **Approximately 490 pages**

**Annual Reviews, Inc., Stanford, California, U.S.A.**
**H. K. Lewis & Company, Ltd., 136 Gower Street, London, W.C. 1, ENGLAND**
**Maruzen Company, Limited, 6 Tori-Nichome Nihonbashi, Tokyo, JAPAN**

# BOROSIL

**LABORATORY GLASSWARE**

*such as*

FLASKS, BEAKERS, CONDENSERS, MEASURING FLASKS, MEASURING CYLINDERS, PIPETTES & ANY SPECIAL APPARATUS MADE TO DESIGN

*and*

PENICILLIN VIALS, VACCINE BULBS—WHITE & AMBER

❖

ALL OTHER APPARATUS & EQUIPMENT MANUFACTURED TO CLIENT'S DESIGN

**INDUSTRIAL & ENGINEERING APPARATUS CO. LTD.**

CHOTANI ESTATES, PROCTOR ROAD
GRANT ROAD, BOMBAY 7

*Latest Developments*

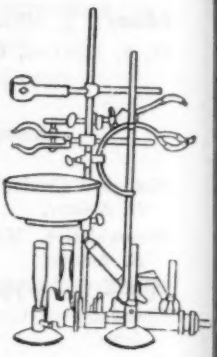
**GAS PLANTS**

now working on cheaper oil than PETROL. Reduce costs still lower.

**OTHER C&S SPECIALITIES**

Burners, Clamps, Baths
Gas and Water Taps
Ovens, Incubators
Shakers, Stands, Stills
Stirrers, Research
Apparatus, etc., etc.
Repairs and Servicing
of Microscopes and
Instruments

*Ask for new Catlg.*



**GANSONS**
**Limited**

P.O.B. 5576, BOMBAY 14

# THERMOSTATIC BATHS

**(WATER OR OIL)**

Various sizes and temperature ranges for general laboratory work. Maximum dimensions 18"×18"×12". Maximum temperature upto 300° C. Accuracy of control to within ± 0·05° C. Efficient Stirring, with glass walls on two sides for good visibility, and metal frame work for strength. Switch board and control box attached to one of the sides.

*Entirely Our Manufacture*

*For full particulars, please write to :*

**THE GENERAL ENGINEERING AND SCIENTIFIC CO.**

WALTAIR, VISAKHAPATNAM-3
(S. INDIA)

*Technical Adviser :*

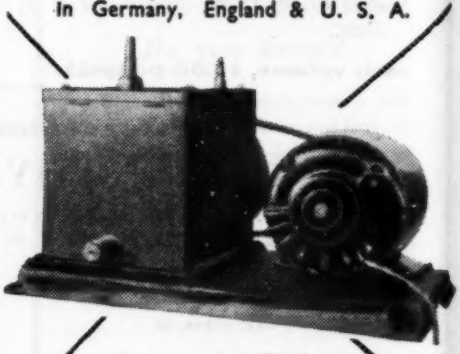
Dr. I. RAMAKRISHNA RAO
M.A., Ph.D. (Cal.), D.Sc. (Lond.)

*MADE IN INDIA*

**HIGH VACUUM ROTARY PUMP**

**Single Stage & Two Stage**

Suitable for Laboratory use and similar in performance to those made in Germany, England & U. S. A.

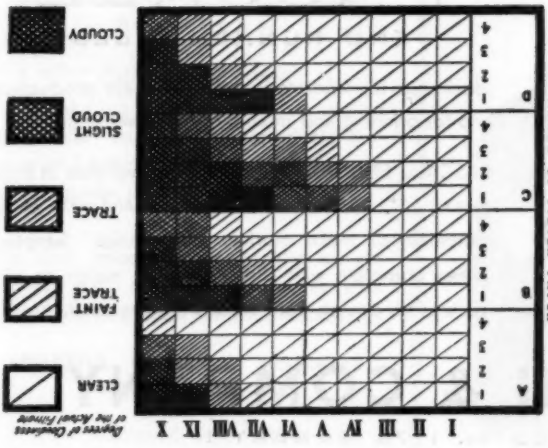


***All Indian Materials and Constructions.***

**BASIC & SYNTHETIC CHEMICALS LIMITED**

P. O. Jadavpur College, Calcutta-32

# A TEST FOR FILTER PAPERS




A FAVOURITE and well-tried test for a filter paper is to examine its performance in filtering a suspension of barium sulphate. T. B. FORD LTD., LONDON, have been examining the possibilities of developing this method, and the process described here may be of considerable general interest.

The method which they adopt is based on the general theory of small-particle formation propounded by von Weimarn, who stated that

Initial rate of condensation (V) =

$$K \frac{\text{condensation pressure}}{\text{condensation resistance}}$$

He suggested that the normal solubility of the precipitate substance is a measure of the condensation resistance, and that the condensation pressure is the difference between the total concentration (Q) momentarily produced as a result of a chemical reaction and the normal solubility S, so that

$$V = K \frac{(Q - S)}{S}$$

If V is large, the rate of condensation is high and the particles will be small. This condition is brought about by having a high value for Q or a low value for S.

Taking 7N solutions mixed in equal quantities they get a momentary concentration of barium sulphate of 3½N, whereas the normal solubility of barium sulphate – the S above – is $2 \times 10^{-5}$N, thus

$$V = 175000$$

However, with the relatively high concentration of electrolyte, coagulation would take place and it is, therefore, preferable to keep Q small and reduce the value of S.

By such considerations they are able to produce an accurately graded series of small particles down to colloidal dimensions (labelled I, II, III, etc., in the diagram on left, the smallest, measuring 0·06 microns, shown as X).

These have been used in a test of a series of FORD FILTER PAPERS the results of which are shown in the diagram. Full information about various grades of FORD papers, and their uses, compiled by the FORD Laboratory Service, can be found in the introduction to their sample book of papers, available free on request.

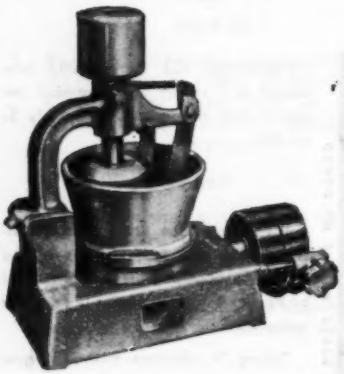
*Sole Agents for Ford Filter Papers:*

## MARTIN & HARRIS LIMITED

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

*for laboratory & small scale production...*



# PASCALL

**END RUNNER MILLS**

Ideal units for laboratory and small-scale production, and for grinding and mixing dry and wet materials.

PASCALL END RUNNER MILLS are available in three sizes; 10", 15" and 20" diameter, and with either porcelain or metal mortars and pestles. Supplied either complete with direct coupled motor or with pulleys for driving from an existing line shaft.

## GIDVANI & COMPANY

POST BOX No. 1778, BOMBAY 1

# WHATMAN

## FILTER PAPERS

Filtration:

QUALITATIVE GRADES
QUANTITATIVE GRADES
HARDENED GRADES

Specialities:

ASHLESS TABLETS & FLOC
ANTIBIOTIC ASSAY DISCS
EXTRACTION THIMBLES

Cellulose Powder for
CHROMATOGRAPHY

Papers for
CHROMATOGRAPHY & ELECTROPHORESIS

ASK YOUR LABORATORY FURNISHER FOR FREE SAMPLES, OR IN CASE OF DIFFICULTY WRITE SOLE MILL REPRESENTATIVES:

**H. REEVE ANGEL & CO., LTD.,** 9, Bridewell Place, London E.C.4, ENGLAND

*Made by:*
**W. & R. BALSTON LTD., MAIDSTONE, ENGLAND**

Telephone: 62761 Grams: 'LABFURNISH'

## Laboratory Furnishers

DHUN MANSION, VINCENT ROAD, DADAR
BOMBAY 14

*We offer from ready stock:*

* Special silica thermocouples for molten steel and corrosive liquids * Thermocouples * Indicators * Recorders * Spares of all popular pH meters

●

We also specialize in repairs of pH meters and scientific instruments plus everything you need for your laboratory:

**APPARATUS, GLASSWARE, METALWARE INSTRUMENTS, etc., etc.**

*Branch Office:*

MOTILAL MANSION, KAPASIA BAZAR
AHMEDABAD 2

**VERY RELIABLE INDIGENOUS SUBSTITUTES OF GUARANTEED ANALYTICAL REAGENTS MAY BE FOUND IN**

## "BASYNTH"

**Brand**
ANALYTICAL REAGENT

Acid Hydrochloric
Acid Hydrochloric Fuming
Acid Sulphuric
Acid Nitric
Acid Nitric Fuming
Acid Acetic Glacial
Ammonium Hydroxide
Benzene
Toluene
Xylene
Petroleum Ether
Amyl Alcohol
Butyl Alcohol Etc., Etc.

**BASIC & SYNTHETIC CHEMICALS LIMITED**
P. O. Jadavpur College, Calcutta-32

## TEMPO

**Electrode Boiler**

**(Patent Pending)**

* An automatic handy device for steam distillation in laboratories.
* Steam at a constant pressure of 9–10" W.G.
* Works on 230 V. A.C.

*For further particulars write to:*

**Tempo Industrial Corporation, Ltd.**
1st Floor, Devkaran Mansion
PRINCESS STREET :: BOMBAY 2

*—RELIABLE HOUSE FOR—*

- ❖ LABORATORY GLASSWARES (Plain and Graduated)
- ❖ THERMOMETERS & HYDROMETERS (Various ranges)
- ❖ LABORATORY PORCELAINWARES & SILICAWARES
- ❖ NICKEL AND PLATINUMWARES
- ❖ WHATMAN FILTER PAPERS
- ❖ MICROSCOPES & ACCESSORIES
- ❖ BALANCES, TINTOMETERS, AEROGEN GAS PLANTS AND OTHER INSTRUMENTS REQUIRED BY CHEMICAL LABORATORIES

*Contact:*

**UNIQUE TRADING CORPN.**
51-53, Babu Genu Road
BOMBAY 2

Gram: 'UNILAB' Phone: 26983

# FRIESEKE & HOEPFNER

(GERMANY)

RADIATION MEASURING

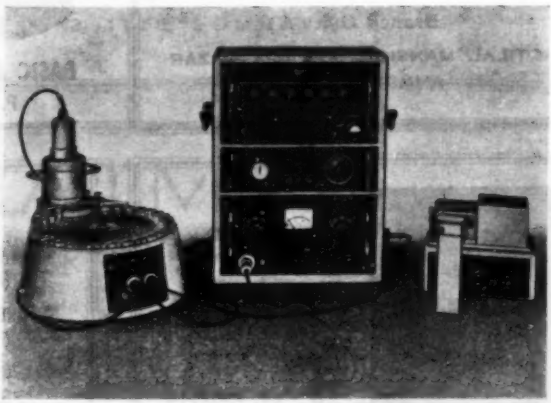
AND

DETECTING INSTRUMENTS AND ACCESSORIES

FOR

MEDICAL, LABORATORY AND INDUSTRIAL APPLICATIONS

A complete range of instruments for the measurement of X and Nuclear Radiations, which have always satisfied the exacting demands of industrial and scientific applications are now available.



The picture shows combined Scalar and Ratemeter FH49 with Automatic sample changer FH448 and Printing Timer FH449.

*Full specifications are available for these and*

**Automatic Chromatogram Scanner, Measuring Bridge for Radio activity, Electrometer, Scintillation counter, G-M tubes, Standard source of Radiation, etc.**

*From*

*Sole Agents in India*

# TOSHNIWAL BROTHERS LIMITED

**198, Jamshedji Tata Road**
**BOMBAY 1**

**3/7, Mutiny Memorial Road**
**NEW DELHI**

**9, Blackers Road**
**MADRAS 2**

Current Science

Vol. XXIV] SEPTEMBER 1955 [No. 9


| | Page |
|---|---|
| *Atoms for Peace and Plenty* .. .. | 289 |
| *Prof. M. S. Thacker* .. .. .. | 291 |
| *Direct Conversion of Radiation into Electricity* .. .. .. .. | 291 |
| *Trichy Phosphatic Nodules: New Possibility of Exploitation as Phosphatic Fertilizer*—A. Mariakulandai, S. Venkatachalam and M. R. Balakrishnan .. .. .. .. | 292 |
| *Genetic Effects of Radiation* .. .. | 293 |
| *Structure of DL-Aspartic Acid*—V. Amirthalingam and G. N. Ramachandran .. .. .. .. | 294 |
| *The Photosynthetic Cycle* .. .. | 295 |
| *Letters to the Editor* .. .. .. | 296 |
| *Reviews* .. .. .. .. | 319 |
| *Science Notes and News* .. .. | 323 |


## ATOMS FOR PEACE AND PLENTY

THE International Conference on the Peaceful Uses of Atomic Energy, which concluded its sessions recently in Geneva, may be said to have fully realised the expectations which it raised. For, apart from its great contribution to the easing of political tensions and paving the way for freeer flow of research information among scientists of all countries, its significance as a scientific conference can hardly be overestimated.

As was pointed out by Dr. H. J. Bhabha, President of the Conference, during its opening session, humanity is in the third great epoch of its history, each of which was marked by a change in the energy pattern of society. It was the unaided human muscle which supplied all the energy for mechanical work during the first epoch, while the second one, which dawned somewhere in the 17th century, ushered in the widespread use of chemical energy in the form of coal and oil. But the energy consumption in the world has gone up in a staggering manner during the three recent centuries, and it is the atom, as the Conference has clearly established, which holds the answer to most of the problems connected with the demand for such supply during the third epoch which we are just entering into.

The present Conference is perhaps the largest ever organised by the United Nations on a subject of universal importance, and was attended by nearly 1,300 scientists, representatives and advisers from 73 countries. Space permits us to make only a brief mention of some of the highlights of the Conference in what follows.

The chief series of discussions in the first few days brought out the economic need for nuclear power in a world in which "conventional" fuel resources are running low, and

foreseeable other resources, such as those of hydro-electric power, are inadequate for the increasing demands of an industrialized world. Nuclear power, it would appear, has come just in time to enable coal and oil to be more widely used in the chemical and allied industries.

The general background to the employment of this new world power source was traced in papers from two of the UN specialised agencies. That submitted by WHO discussed the general problems of protection against radiations from the public health point of view. Potential dangers were considered as coming from two main sources: firstly, in radioactive wastes from reactors, and secondly, on account of the increasing distribution and use of radioisotopes. One point which was brought out was that the long-lived by-products of reactors are likely to be in such demand for many years to come that their disposal is not expected to become a problem for some years to come. Above all, it was emphasized, protection must depend on education, not only of the necessary personnel for this new work, but also of the general public.

The second of these general papers dealt with the possible results of the application of atomic energy to increasing production in agriculture, forestry and fisheries. This paper, presented by FAO, reviewed the whole field and stressed the fact that while it would be some time before cheap nuclear power was available in sufficient quantity to make a direct contribution, there was already a vast field in which radiation, and even more, radio-isotopes, were contributing to speed up production through their use as research tools. In fact, it was suggested that the value of nuclear energy in helping to feed, clothe and house the rapidly increasing population of the world might be even greater than its importance as a new source of power.

Of the papers in the first of three technical sections of the Conference, those dealing with nuclear physics and with reactors gave a complete survey of the progress made so far in these important fields. In this connection there was a series of announcements from physicists of UK, USA and USSR which showed that in all three countries, almost identical results had been obtained for one of the fundamental measurements in this field, namely, the number of neutrons emitted per fission. The greater the accuracy with which this number is known, the more efficiently can nuclear energy be used.

On the reactor side, descriptions were given of many types of reactors already in use, ranging from small research reactors to those so far built for actual power production. Beyond this, detailed plans were disclosed and discussed which show that many of the smaller nations, such as the Netherlands and Norway, are already well advanced and making important original contributions in this field. Though at present research reactors are attracting most attention, they will soon be followed by the design and construction of prototype reactors for power production. But it will be sometime before full-scale nuclear power plants are in operation, except in one or two countries where plans are already very well advanced. A catalogue of reactors so far built was contained in a paper submitted by UNESCO, which summarized the available information to give a complete picture of the situation in this respect.

Another highlight of the Conference was the demonstration of the importance of thorium for the production of atomic energy and the possibility of a positive gain factor in the conversion of fertile to fissile material in the thorium-U233 system which was shown to be superior to the uranium 238-plutonium system in several ways. The breeding of atomic fuel in fast neutron reactors also held out exciting possibilities.

The second technical group of sessions, dealing with chemistry, metallurgy and technology, opened with a general review of the natural occurrence of uranium and thorium, from which emerged the encouraging picture of a plentiful supply of these essential raw materials—a picture which was based on no less than 94 papers submitted to this session. Prospecting problems and techniques were discussed with special reference to aerial survey methods. Less familiar aspects of the chemistry of fission, and problems of handling the highly radioactive materials produced in the fission process were also dealt with in a number of papers.

In the biological and medical sessions, medical applications of radioisotopes, ways and means of handling these materials, clinical and diagnostic work were some of the more important subjects dealt with. Advances in this field were evident in many countries.

Discussions ranged from such public health problems as the study of epidemic communicable diseases to the application of isotopes in studying the biochemistry of muscles. Later, various aspects of radiation injury were dealt

with, during which there was discussion of the possible effects of a general increase in the level of radio-activity in the world as a whole. From these discussions it was evident that the use of radioisotopes in medicine is one of the outstanding contributions which nuclear energy is already making to the welfare of mankind.

On the general side, the feasibility of generating electricity by atomic energy was demonstrated beyond doubt, and the economics of atomic power generation was also greatly clarified. There would appear to be good reasons for expecting that capital costs of atomic power stations would come down during the next decade. Even with present costs, it was shown, atomic power stations would be economically competitive with power stations of a conventional type in many areas of the world where power costs are high.

Certainly the meeting of the world's specialists in the atomic sciences marked a new departure in international co-operation and was not marred by politics. It will go down in history as a major achievement of the United Nations.

## PROF. M. S. THACKER

PROF. M. S. THACKER has been appointed Director, Scientific and Industrial Research. He took charge of his office on August 3, 1955.

Prof. Thacker received his early education in Ahmedabad and Bombay, and proceeded to Europe at an early age. He graduated in engineering from the Bristol University and undertook post-graduate research in the Department of Electrical Engineering of the same University. Later, he joined the Bristol Corporation Electricity Department as an engineer. He returned to India in May 1931 and joined the Calcutta Electric Supply Corporation, Calcutta, as a covenanted officer. He continued there till 1947, when he was invited to take up the Professorship of the newly created Department of Power Engineering, Indian Institute of Science, Bangalore. In 1949, he was appointed Director of the Institute.

Prof. Thacker is the author of numerous papers and memoirs in the field of power technology and high voltage engineering. During the past eight years, he has actively participated in a number of international conferences and committees as an expert delegate from India.

He has also been intimately associated with many scientific and technical organizations in India and assisting several States in the development of power resources and distribution of electricity supplies. His counsel has been much sought by numerous committees and boards concerned with research and technological education and by several Universities in the country and outside. On the last Republic Day the President conferred on Prof. Thacker the award of *Padma Bhushan*.

We wish Prof. Thacker success in his new assignment.

## DIRECT CONVERSION OF RADIATION INTO ELECTRICITY

PRODUCTION of electricity by direct conversion of atomic energy should be considered as a possible auxiliary power source, according to Dr. Ernest G. Linder, Paul Rappaport and J. J. Loferski, of the Radio Corporation of America, in a paper presented to the International Conference on Peaceful Uses of Atomic Energy at Geneva.

Discussing various known methods of converting atomic energy directly to electrical energy, Dr. Linder gives particular attention to the semi-conductor type of device employing radioactive material in conjunction with materials such as silicon or germanium—the method used in the experimental atomic battery announced by RCA in early 1954. In this type of conversion unit, high current multiplication is achieved in the semi-conductor material. For example, each beta particle produced by strontium-yttrium-90 radioactive source material produces in turn about 200,000 new electrons as it penetrates a silicon target, increasing output current and reducing internal impedance by a similar factor. However, power sources using radioactive material cannot be considered truly practical until solutions are found to problems of high cost of radioactive material, efficient shielding, radiation damage to target material bombarded by beta particles, and low efficiency.

At the present time, the available isotope nickel-63 meets all of the requirements except that of cost, but it is hoped that attention will be given to this and other materials in the same category.

# TRICHY PHOSPHATIC NODULES: NEW POSSIBILITY OF EXPLOITATION AS PHOSPHATIC FERTILIZER

A. MARIAKULANDAI, S. VENKATACHALAM AND M. R. BALAKRISHNAN

*Agricultural Research Institute, Coimbatore*

THE Trichy phosphatic deposits, estimated at 8 million tons,[1] is found spread over an area of 10 square miles to a depth of 200′ near Utathur Village of Ariyalur taluk in Tiruchirapalli District of the Madras State. The phosphatic material is available in the form of nodules and contains about 25·6% $P_2O_5$ and 17% $CaCO_3$. The phosphate in the nodules is in a form not readily available to plants due to its very low citric solubility. Attempts have been made since 1892 to convert this rich source of phosphatic material into mono-calcium phosphate as in superphosphate using sulphuric acid, so as to be available to plants. It was estimated that in the process, only 35·44% of the sulphuric acid was profitably utilised for the conversion of tricalcium phosphate to mono-calcium phosphate, while 37·68% was wasted in reacting with calcium carbonate and iron and aluminium oxides present as impurity in the raw material. This resulted in the cost of super prepared from this material to be nearly 2·5 times higher than super prepared from other sources. Consequently, the method proved highly uneconomical. However, the latest techniques in the processing of phosphate rocks have given methods in which the sulphuric acid process could be avoided. Of the various processes available, it was felt that the conversion to 'phosphate-rock-magnesium silicate glass' might best serve to render the phosphorus in Trichy nodules available to plants for reasons of economy and usefulness. Such a product would be similar to the silicophosphate used by the authors in a previous study[2] to combat phosphate reversion in lateritic soils of the Nilgiris.

The present study was therefore directed towards finding out the most suitable ingredients containing magnesia and silica for obtaining a highly citric soluble fertilizer from the Trichy nodules.

Pure salts of magnesia and silica were used at first and were later substituted, as far as possible, by cheaply available raw materials such as olivine and serpentine obtained from the magnesite mines at Salem.

Selected nodules giving a $P_2O_5$ content of 28% were powdered to pass through a 50-mesh sieve and mixed thoroughly in a mortar with the other components under study, using a small quantity of water to facilitate pelletting. Pellets of the size of playing marbles were made and were dried in an oven at 150° C. The fusion of the mixture is generally done in a triple arc furnace at 1550° C.[3]; but as this facility was not available locally, oxy-acetylene flame was used in all mixtures studied, excepting for Mixture No. 34 which was fused in a graphite arc at the Electro-Chemical Research Institute, Karaikudi. The pellets were placed on a firebrick and fused one by one in the oxy-acetylene flame. The hot fused mass was immediately quenched in cold water.

The fused product thus obtained was powdered to pass through a 90-mesh sieve and analysed for "total $P_2O_5$", which was estimated volumetrically after digestion with a mixture of 1 : 1. HCl to which a few ml. of $HNO_3$ was added, while "available $P_2O_5$" was estimated in the 2% citric acid extract (Wagner's method).

The results are presented in Table I.

TABLE I

*Showing the total and available $P_2O_5$ in the different fused products*

| Mixture No. | Composition of mixture | Total $P_2O_5$ % | Available $P_2O_5$ % | $P_2O_5$ rendered soluble in 2% citric acid as % of total |
|---|---|---|---|---|
| 7 | 10 : 6-T.P : $MgSO_4$ | 29·57 | 4·83 | 16·33 |
| 12 | 10 : 6-T.P : $Na_2SiO_3$ | 19·15 | 7·70 | 40·22 |
| 6 | 10 : 3 : 3-T.P : $MgSO_4$ : $Na_2SiO_3$ | 23·42 | 12·75 | 54·44 |
| 16 | 10 : 6-T.P : Olivine | 19·68 | 5·66 | 28·76 |
| 19 | 10 : 6-T.P : Serpentine | 19·74 | 5·73 | 29·02 |
| 22 | 10 : 3 : 3-T.P : Olivine : $CaSO_4$ | 22·15 | 5·60 | 25·28 |
| 27 | 10 : 3 : 3-T.P : Olivine : $Na_2SO_4$ | 19·70 | 14·10 | 71·57 |
| 23 | 10 : 3 : 3-T.P : Serpentine : $CaSO_4$ | 22·15 | 5·60 | 25·28 |
| 34 | 10 : 3 : 3 T.P : Serpentine : $Na_2SO_4$ | 21·65 | 20·65 | 95·33 |

(T.P. stands for Trichy phosphatic nodules)

From these data the following conclusions may be drawn :—

(i) Of the pure salts tried, a mixture of magnesium sulphate and sodium silicate is superior to either of them alone.

(ii) The olivine and serpentine rocks of Salem can be used as sources of magnesia and silica, but these by themselves were not sufficient to bring about the maximum solubility of $P_2O_5$ in the Trichy nodules. The presence of sodium sulphate in the fusion mixture gave the best results and was better than calcium sulphate used in the study.

(iii) The fusion of a mixture of 10 : 3 : 3 of Trichy phosphate, serpentine and sodium sulphate, using graphite arc for fusion. has rendered 95% of the phosphate available to plants.

Our thanks are due to Sri. Padmanabhan, Chief Chemist of the Madukarai Cement Factory, and to the Director of the Electro-Chemical Research Institute, Karaikudi, for facilities given for the fusion of the mixtures tried in this study.

1. Sivan *et al.*, *Mem. Dept. Agri. Madras*, 1925, **7**, 162.
2. Mariakulandai, A., Venkatachalam, S. and Rajagopala Iyengar, T., *J. Ind. Soc. Soil Sci.*, 1955, **3**, 15.
3. Moulten, R. W., *Chem. Eng.*, 1949, **56** (7), 102.

## GENETIC EFFECTS OF RADIATION

THE dangers to man's heredity—the effects on the unborn generations of humans exposed to atomic radiation—may be greater than has been generally supposed, according to Dr. W. L. Russell, of the Oak Ridge National Laboratory, U.S.A., in a paper prepared for the International Conference on Peaceful Uses of Atomic Energy in Geneva, Switzerland.

Dr. Russell states that while the average radiation-induced mutation rate in his experiments with mice was about ten times higher than that in similar experiments with fruit flies, mutation rates from radiation in man are not known. So far, human radiation-induced mutation rates were estimated on the basis of fruit fly results, but it is reasonable to suppose that the mutation rates in man are more like the rates in mice than those in fruit flies. Therefore, calculations of human hazards on the basis of fruit fly mutation rates may have seriously underestimated the damage in man.

Information on another important problem is presented in Dr. Russell's paper. It has sometimes been suggested that the probability that the offspring of an irradiated individual will inherit a mutation might decrease as the interval between irradiation and conception increased, *i.e.*, that there is "recovery" from genetic damage. Earlier work with mice had shown that the probability of transmitting some types of mutations does decrease for a few weeks after irradiation as the father exhausts the germ cells that were irradiated in the later maturing stages.

However, it was not known whether there would be any further decrease after this interval. It was desirable to have this particular problem investigated on an organism such as the mouse which has a life-span considerably longer than that of the fruit fly and which has male sex glands that are anatomically similar to those of man.

Dr. Russell states that analysis of his data on mutations induced in mice showed no significant change in mutation rate with time after irradiation. Offsprings conceived long after exposure of the father to radiation are just as likely to inherit induced mutations as are those conceived a few weeks after exposure. In practical terms, the results of the work on mice indicate that, although postponement of procreation for a few weeks following exposure to radiation would reduce the total risk of transmission of mutational changes, by excluding those induced in the maturing sex cells, further postponement would not give any additional reduction in risk.

It would appear that adequate protection against the genetic hazards of peaceful uses of atomic energy may require a limitation not only of the average dose of radiation received by the population as a whole, but also of the dose accumulated by individuals. It may be added that the magnitude of the first generation effects already observed in mice suggests that it is quite possible that, if the present permissible weekly dose is to be kept, a total accumulated dose limit may have to be established to protect the individual from incurring too great a risk of damage to his own offspring.

# STRUCTURE OF DL-ASPARTIC ACID

V. AMIRTHALINGAM AND G. N. RAMACHANDRAN

*Dept. of Physics, University of Madras, Guindy, Madras-25*

IN a recent report,[1] Saito, Cano-Corona and Pepinsky have reported the structure of L-asparagine monohydrate, $[CO(NH_2).CH_2.CH(NH_2).COOH, H_2O]$ in which they find that no cyclic structure is formed by internal hydrogen bonding, although such a structure has been suggested by Steward and Thompson[2] on the basis of the chemical properties of the compound. Aspartic acid $[COOH.CH_2.CH(NH_2).COOH]$ is very similar in constitution and it is possible for a six-membered ring to be produced by one of the hydrogens of the amino group being attached to an oxygen of the carboxyl group by a hydrogen bond. In fact, such a structure has been postulated from chemical considerations by Stehlik and Liskova[3] for aspartic acid.

TABLE I

*Co-ordination of atoms in DL-aspartic acid structure*

| | | $x$ | $y$ | $z$ |
|---|---|---|---|---|
| $C_1$ | .. | 0·038 | 0·161 | 0·049 |
| $C_2$ | .. | 0·079 | 0·094 | 0·134 |
| $C_3$ | .. | 0·000 | −0·017 | 0·199 |
| $C_4$ | .. | 0·027 | 0·047 | 0·290 |
| $O_1$ | .. | 0·106 | 0·114 | −0·011 |
| $O_2$ | .. | −0·092 | 0·236 | 0·094 |
| $O_3$ | .. | 0·134 | −0·060 | 0·308 |
| $O_4$ | .. | −0·058 | 0·154 | 0·312 |
| N | .. | −0·133 | 0·081 | 0·208 |

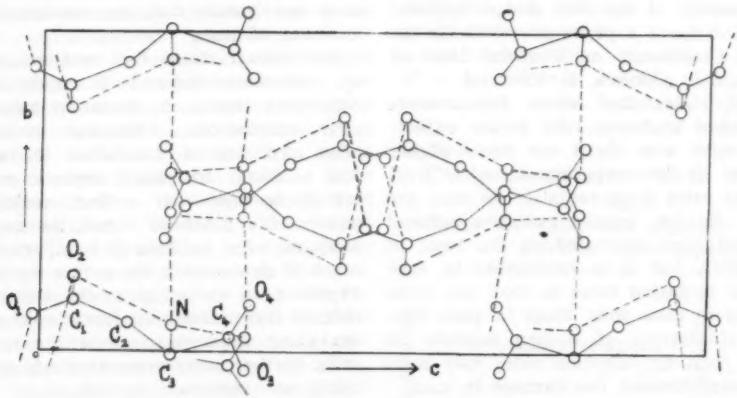



FIG. 1. Projection of structure on (100) plane.

The crystal structure of DL-aspartic acid has been determined by X-ray methods and it is found that an integral hydrogen bond definitely exists in this compound. The crystal is monoclinic with $a = 9{\cdot}18$A, $b = 7{\cdot}49$A, $c = 15{\cdot}79$A, $\beta = 96°$ and belongs to the space group I 2/a with 8 molecules per unit cell.[4] The structure was determined by a combination of trial and error methods making use of models, with the Patterson projection along $a$ and $b$ axes and signs determined by inequality methods. Both Fourier projections have large overlaps of atoms and the final positions of atoms were fixed from considerations of bond lengths and bond angles and by making use of an error synthesis. Table I gives the co-ordinates finally chosen; the positions of atoms are expected to be correct to 0·1A. The symbols for the atoms in this table are the same as those marked in Figs. 1 and 2, which give the projections of a unit cell on the (100) and (010) planes. The hydrogen bonds are indicated by dotted lines. The agreement between calculated and observed structure factors is fairly satisfactory, the R-values being 0·25 and 0·20 for the $a$ and $b$ projections.

As will be seen from the figure, (i) the molecule of aspartic acid has the zwitterion structure with three hydrogens attached to the nitrogen; (ii) one of the three hydrogen atoms is internally hydrogen bonded to the oxygen atom $O_2$ while the other two are bonded to

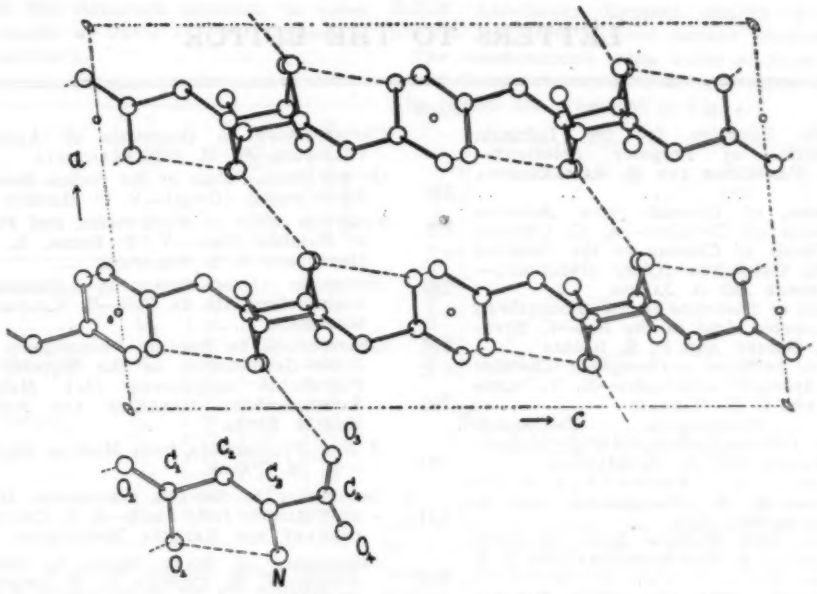



FIG. 2. Projection of structure on (010) plane.

oxygen atoms $O_3$ of different molecules; (iii) the molecule has its chain length nearly parallel to the long axis (c) and two molecules in a line are linked together mutually by means of hydrogen bonds formed between their carboxyl groups.

1. Saito, Y., Cano-Corona, O. and Pepinsky, R., *Science*, 1955, **121**, 435.
2. Steward, F. C. and Thompson, J. F., *Nature*, 1952, **169**, 739.
3. Stehlik, B. and Liskova, N., *Chem. Zvesti*, 1950, **4**, 60
4. Dawson, B. and Mathieson, A. McL., *Acta Cryst.*, 1951, **4**, 475.

## THE PHOTOSYNTHETIC CYCLE

IN a paper presented before the International Conference on the Peaceful Uses of Atomic Energy, Professor Calvin of the University of California, Berkeley, U.S.A., has described the theory of a "photosynthesis battery" which has resulted from the researches of his group. The use of radioactive carbon to trace the source of chemical reactions in the plant has given insight into the order in which the plant makes chemicals and the way in which it takes energy from the sun and uses it for the chemical reactions.

By developing precise and delicate methods for separating and measuring the radioactive compounds formed by the plant, Prof. Calvin's group have isolated some fifteen compounds and traced the reactions needed for the complete process from $CO_2$ to sucrose. Compounds made by the plant in the first few seconds, sometimes in amounts less than a fraction of a microgram, were isolated and measured.

Studies of the carbon reduction cycle have led to a new theory as to how the energy absorbed by the chlorophyll from the sun is used to split the water molecule. This theory proposes an arrangement like a tiny battery, made of layers of chlorophyll between the microscopically thin layers of fat and protein. The battery absorbs sunlight and uses the energy of the sunlight to split the water molecule. The electrons freed from the water are held by a compound believed to contain sulfur until they are used by the enzymes in the carbon reduction cycle.

With this detailed knowledge it is claimed that it should be possible not only to increase crop growth but also to vary the kind of products obtained and to use small plants as factories for the production of concentrated fat, protein or sugar, as desired. With more knowledge of the "photo-synthetic battery" it should also be possible to devise more efficient means of converting solar energy to a form which can be used for power or fuel.

# LETTERS TO THE EDITOR


| | Page |
|---|---|
| *Sakurada Equation for the Intrinsic Viscosities of Polymer Solutions*—V. V. Varadaiah and M. Ramakrishna Rao | 296 |
| *Adsorption of Glucose from Aqueous Solutions on Cellulose*—A. G. Chitale | 297 |
| *Biosynthesis of Choline in the Seedling of the Chick-Pea* (Cicer arietinum)—K. Ahmad and A. Jabbar | 298 |
| *The Role of Thiamine in the Biosynthesis of Ascorbic Acid in the Rat*—K. Sivarama Sastry and P. S. Sarma | 298 |
| *Reaction between o-Phenylene Diamine and Aromatic Aldehydes*—N. V. Subba Rao and C. V. Ratnam | 299 |
| *Fused Heterocyclic Compounds from 3-Ethoxycarbonyl-4-Piperidones*—V. Baliah and A. Ekambaram | 301 |
| *Synthesis of Furano-(3′ : 2′ : 6 : 7)-Flavone*—S. K. Pavanaram and L. Ramachandra Row | 301 |
| *Diffusion with Multiple Zones of Interaction*—C. S. Ramakrishnan and J. B. Pande | 302 |
| *Vitamin $B_{12}$ and Rice Moth Larvæ*—R. V. Bhagwat and Kamala Sohonie | 303 |
| *The Proteolytic Activity of Rabbit Brain Thromboplastin and Its Inhibition by Heparin*—(Mrs.) Shanta S. Rao and Dr. S. S. Rao | 304 |
| *The Parietal Organ in* Calotes versicolor (*Daud.*)—V. Ananthanarayanan | 305 |
| *Enzyme Complex of the Corpus Allatum of the Female* Iphita limbata *Stal.*—K. K. Nayar | 306 |
| *The Cervical Extensions of the Thymus in* Loris lydekkerianus (*Cabr.*) *and Their Significance*—B. A. Ghulam Ahmad and M. Appaswamy Rao | 307 |
| *Chromosomes in Oogenesis of* Ascaris vitulorum—K. H. Neelakantaiya | 308 |
| *On the Bony-Palate of the Indian Hawk,* Falco jugger (*Gray*)—V. D. Mathur | 308 |
| Fusarium *Wilts of Watermelon and Peas in Bombay State*—V. P. Bhide, R. K. Hegde and R. S. Sukapure | 310 |
| *Antibiotic Production by* Fusarium vasinfectum *Atk. in Soil*—R. Kalyanasundaram | 310 |
| *Observations on Nuclear Phenomenon of Spore-Germination in the Mycelia of* Polystictus sanguineus (*L.*) *Mey.*—Sachindranath Banerjee and Asoke Kumar Sinha | 311 |
| *A New* Phyllactinia *from Madhya Bharat*—M. M. Payak | 312 |
| *Occurrence of* Serratia marcescens *Bizio on Cutworm from India*—S. B. Chattopadhyay and Krishna Mukherjee | 313 |
| *Inheritance of Waxy Bloom in Wheat Plants*—V. M. Chavan, G. P. Argikar, P. S. Hattiangadi and M. S. Salanki | 314 |
| *Effect of S/Se and Ca/B Ratios on Growth and Sap Characteristics of Sugarcane*—K. N. Lal and J. N. Tandon | 314 |
| *A Technique of Whole Mounts for the Study of Floral Anatomy*—Ramji Sharma | 315 |
| *Use of Synthetic Hormone to Step Up Sugar in Cane*—A. S. Chacravarti, D. P. Srivastava and K. L. Khanna | 316 |
| *Ability of the White-Fly to Carry More Than One Virus Simultaneously*—P. M. Varma | 317 |


## SAKURADA EQUATION FOR THE INTRINSIC VISCOSITIES OF POLYMER SOLUTIONS

The increase in viscosity $\eta$ of a polymer solution over that of a pure solvent $\eta_0$ is expressed as a fraction called the specific viscosity $\eta_{sp}$ given by $\eta_{sp} = \eta - \eta_0/\eta_0 = \eta_r - 1$, where $\eta_r$ is termed the relative viscosity. Intrinsic viscosity of a solution is defined as $[\eta] = \lim_{c \to 0} \eta_{sp}/c$, where $c$ is the concentration of the polymer and is obtained by drawing a graph between $\eta_{sp}/c$ and $c$ and extrapolating it to $c = 0$. $[\eta]$ is an important constant of the polymer system and it is related to the molecular weight of the polymer. Sakurada[1] proposed for fractions of polymethyl methacrylate solutions that $[\eta] = 3(\eta_r^{\frac{1}{3}} - 1)/c$, where $c$ is the concentration in gm./100 c.c. He claimed that this equation was applicable to polymethyl methacrylate fractions up to a value of six for $\eta_r$ and for some polystyrene fractions also. This equation has the great merit of giving the value of $[\eta]$ with $\eta_r$ determined at one concentration only and thus saves a lot of labour involved in finding $[\eta]$ by the graphical method. A large amount of viscosity data on fractions of polyvinyl acetate, polystyrene and polymethyl methacrylate is available with the authors in connection with a study of the light scattering behaviour of these polymer systems. Sakurada equation was found to be applicable in all the above cases in the range of $\eta_r$ values investigated. $[\eta]$ values determined by graphical

method and the Sakurada equation, in some cases, are shown in Table I. The agreement is very satisfactory.

TABLE I

| Polymer solution | Name of fraction | $\eta_r$ | $[\eta]$ from graph 100 ml./g. | $[\eta]$ calculated from Sakurada equation |
|---|---|---|---|---|
| Polymethyl-methacrylate in acetone | $M_1$ | 1·37 | 1·75 | 1·75 |
| | | 1·72 | 1·75 | 1·78 |
| | $M_2$ | 1·28 | 2·75 | 2·78 |
| | | 1·97 | 2·75 | 2·80 |
| Polymethyl-methacrylate in chloroform | $M_3$ | 1·53 | 3·25 | 3·22 |
| | | 2·20 | 3·25 | 3·28 |
| | $M_4$ | 3·37 | 2·85 | 2·89 |
| Polystyrene in benzene | $S_1$ | 1·35 | 0·42 | 0·43 |
| | $S_2$ | 2·21 | 1·10 | 1·17 |
| Polyvinyl acetate in benzene | $V_1$ | 2·15 | 2·21 | 2·20 |
| | $V_6$ | 2·70 | 1·47 | 1·55 |
| | $V_9$ | 1·63 | 0·77 | 0·77 |
| | $V_{10}$ | 1·21 | 1·25 | 1·24 |

The authors desire to express their thanks to Professor S. Bhagavantam for his interest in the work.

V. V. VARADAIAH.
M. RAMAKRISHNA RAO.

Physical Labs.,
Osmania University,
Hyderabad, *August* 5, 1955.

1. Sakurada, I., *Chem. High Polymers* (Japan), 1945, 2, 253.

## ADSORPTION OF GLUCOSE FROM AQUEOUS SOLUTIONS ON CELLULOSE

ALTHOUGH the adsorption of a variety of compounds has been studied in case of cellulose, it appears that the adsorption of glucose has received no attention. This study should be of some interest because of the similarity of the structure of glucose and cellulose.

The experimental procedure was as follows: about 1 g. of viscose staple fibre (1·5 denier), on dry basis, was weighed out into a glass-stoppered flask, 50 ml. of glucose solution of known concentration were added, and the flask was kept in a thermostat for 5-5½ hours, with frequent shaking. The solution was then separated by filtering through a very small amount of glass-wool to retain any loose fibres. It was kept overnight before measuring the equilibrium concentration. The concentrations were measured by means of a Hilger and Watts microptic polarimeter reading to 0·01 degree. B.D.H. Laboratory Reagent quality d (+) glucose was used without further purification.

The measurements were made at three different temperatures, *viz.*, 20°, 30° and 40° C. The results are presented in Fig. 1.

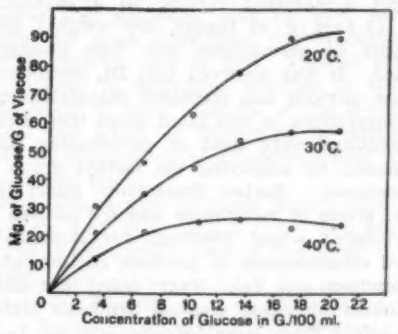



FIG. 1

It is seen that the magnitude of the adsorption is not very large, the maximum at 20° C. for a 20% solution being about 15% on the basis of the amorphous region in viscose. Two reasons can be offered for this behaviour. Firstly, the glucose molecules may not be able to penetrate into the finer pores and so the surface available to them will be limited. The second more important reason is that cellulose may not show any particular preference towards glucose because its affinity for hydrogen bonding substances can also be satisfied by the water from the solution. The molecules of surface-active agents and dyestuffs contain hydrophobic parts which try to drive them out of the solution and so such compounds tend to concentrate at any interface, even the air-water interface in the absence of an absorbent. In the system cellulose-glucose-water, on the other hand, all the components have similar hydrogen bonding properties and strong mutual preference between any two is absent.

As usual, it is found that the adsorption decreases with iscreasing temperature. The effect, however, is quite marked; the adsorption decreases by 60-70% as one passes from 20° C. to 40° C. Also, the maximum value of adsorption is reached at lower concentrations as the temperature is increased.

The results of other workers with dyes and surface-active agents are reported at concentrations which are very much lower than those used here, and so a comparison is not possible.

ATIRA, A. G. CHITALE.
Ahmedabad-9,
*July* 18, 1955.

## BIOSYNTHESIS OF CHOLINE IN THE SEEDLING OF THE CHICK-PEA (*CICER ARIETINUM*)

In a previous report[1] it was shown that the germinating seedlings of *Cicer arietinum* grown in light synthesized choline to a maximum value (3·8 mg./g. of tissues, dry weight) after 96 hours of germination and then gradually declined. It was observed that DL methionine, creatine, acetone and methanol stimulated choline biosynthesis in this plant when their aqueous solutions were used as germinating fluid, presumably by supplying the methyl group or its precursor. Earlier Steensholt[2] found that methyl group of methionine was not utilised by the etiolated wheat seedlings for N-methylation of ethanolamine to produce choline while Barrenscheen and Valyi-Nagy[3] noted that added methionine increased creatine synthesis sixfold to eightfold from guanidoacetic acid by 7-day old wheat seedlings. Kirkwood and Marion[4] reported that on feeding $C^{14}$ labelled formate to sprouting barley, the $C^{14}$ carbon showed up in the methyl group of choline and hordenine. More recently Cromwell and Rennie[5] have found that the biosynthesis of choline was stimulated to a marked degree in the etiolated wheat seedlings when N-methylethanolamine or dimethylethanolamine were fed either alone or in combination with methionine and/or formate. Ethanolamine under the same conditions did not result in any significant increase in the choline content of the tissue. Feeding of formate alone also produced no increase in choline content of wheat.

The present report is concerned with the effect of ethanolamine and formate in the biosynthesis of choline in the chick-pea.

The experimental procedure and methods are as previously described.[1] The seeds were soaked for 12 hours in the neutralised aqueous solutions of the precursors and allowed to germinate for 96 hours on sand-bed. The results are given in Table I.

Table I

*Effect of ethanolamine and sodium formate on the biosynthesis of choline in the germinating seedlings of* Cicer arietinum

| Germinating fluid | Choline chloride content of seedlings (mg./g. dry wt)* | Stimulation of biosynthesis† |
|---|---|---|
| Water (control) .. | 3·84 | .. |
| 0·01 M Ethanolamine .. | 5·23 | 36·2 |
| 0·01 M Sodium formate | 4·35 | 13·8 |

* Average of 4 determinations; † As per cent. over the control.

It is quite clear that unlike the findings with etiolated wheat seedlings,[5] both ethanolamine and formate when present singly serve as precursors for the biosynthesis of choline in the chick-pea. The use of sodium formate instead of potassium formate was to avoid the stimulatory effect of potassium ion itself.[1] The observation with formate is therefore similar to that made with sprouting barley.[4] While chicks[6] are not able to utilise ethanolamine as a precursor of choline, ethanolamine is readily converted into choline in the rat.[7] The stepwise methylation of ethanolamine is also a metabolic reaction in *Neurospora crassa*.[8] This differential synthetic activity of wheat and chick-pea seedlings is not therefore surprising.

Biochemistry and Nutrition Laboratory, Dacca University, East Pakistan, *February* 14, 1955.

K. Ahmad.
A. Jabbar.

1. Ahmad, K. and Karim, M. A., *Biochem. J.*, 1953, **55**, 817.
2. Steensholt, G., *Acta physiol. scand.*, 1946, **11**, 136.
3. Barrenscheen, H. K. and Valyi-Nagy, T. von, 1942, *Hoppe-Seyl. z* 277, 97.
4. Kirkwood, S. and Marion, L., *Canad. J. Chem.*, 1951, **29**, 30.
5. Cromwell, B. T. and Rennie, S. D., *Biochem. J.*, 1954, **58**, 322.
6. Jukes, T. H., *J. Nutr.*, 1941, **22**, 315.
7. Stetten, D. Jr., *J. Biol. Chem.*, 1941, **138**, 437.
8. Fruton, J. S. and Simmonds, Sofia, *General Biochemistry*, 1953, John Wiley, p. 708.

## THE ROLE OF THIAMINE IN THE BIOSYNTHESIS OF ASCORBIC ACID IN THE RAT

Sure, Theis and Harrelson[1] suggested as early as in 1939 that thiamine may be involved in the biosynthesis of ascorbic acid in the rat. Subsequently, others have confirmed this finding.[2-4] In plants also the necessity of thiamine was shown by Bharani, Shah and Sreenivasan.[5] It is now fairly established that the pathway

Glucose → Glucuronic Acid → Gulonic Acid → Ascorbic acid

represents one of the important pathways whereby this vitamin is synthesized.[6,7] Gulonic acid as a precursor and its position in the reaction sequence has yet to be established conclusively by tracer work.

The work of Roy *et al.*[2] and Mosbach *et al.*[11] suggests that thiamine may have some role either in the synthesis of glucuronic acid or its subsequent conversion to ascorbic acid. In the

present study an attempt has been made to determine whether thiamine has any such role in the biosynthesis of ascorbic acid.

Albino rats, weighing about 100 g. each, were fed a diet of the following composition: casein (vitamin free) 18, sucrose 67, salts[8] 4, gingelly oil 10, vitamin mixture 1. The vitamin mixture was made up of pyridoxine hydrochloride 0·05, riboflavin 0·05, nicotinic acid 0·25, calcium pantothenate 0·25, inositol 0·80, p-aminobenzoic acid 0·50, choline chlordie 6·0 and glucose 42·6.

One group of four rats received adequate thiamine (24 γ per rat per day) and served as controls. Another group received instead of thiamine, its antivitamin, neopyrithiamine hydrobromide, orally at a level of 4 mg. per rat per day for a period of one week.

After deficiency symptoms had set in and a steady state reached in the urinary excretion of ascorbic acid, the amount of the vitamin excreted during a twenty-four hour period was determined. The rats were then given glucurone subcutaneously at a level of 100 mg. per rat. The excretion of ascorbic acid, as well as glucuronic acid during the next twenty-four hours were studied. Ascorbic acid was estimated by indophenol titration,[9] and glucuronic acid with naphtho-resorcinol.[10] The results are presented in Table I.

TABLE I

*Influence of thiamine deficiency on the utilisation of glucuronic acid*

| Rat Group | Ascorbic acid Excretion (mg./rat/day) A | Ascorbic acid Excretion (mg./rat/day) B | Mean increase in Ascorbic acid mg. | Glucuronic acid excretion (mg./rat/day) |
|---|---|---|---|---|
| *Controls* | 0·70–1·30 Av. 0·93 | 1·10–2·00 Av. 1·58 | 0·65 | 62·2–64·4 Av. 63·3 |
| Thiamine Deficient | 0·60–0·70 Av. 0·65 | 0·65–0·90 Av. 0·76 | 0·11 | 31·1–37·7 Av. 34·4 |

A—Before injection; B—After injection.

From the data, it can be seen that the thiamine-deficient organism shows a very much decreased conversion of glucuronic acid to ascorbic acid as compared with normal, showing thereby that thiamine is necessary for the proper utilisation of glucuronic acid for ascorbic acid synthesis.

Further, the thiamine-deficient rats excrete about 45% less glucuronic acid than the controls. It is possible that this is due to an increased catabolism of glucuronic acid in the thiamine-deficient organism, in which case the observed impairment of ascorbic acid synthesis from glucuronic acid may also be, to a certain extent, due to this latter cause. But that this cannot be the primary cause of the observed phenomenon is, however, obvious since the glucuronic acid excretion falls by 45% whereas, under the same conditions, the corresponding fall in ascorbic acid is 84%. Further work is in progress to determine whether in cases of deficiencies of other vitamins of the B-complex where the effect of chloretone is suppressed such an impairment of glucuronic acid utilisation takes place.

The authors wish to thank Messrs. Corn Products Co. Ltd., N.Y. (U.S.A.), for their generous gift of the glucurone used in the above investigation.

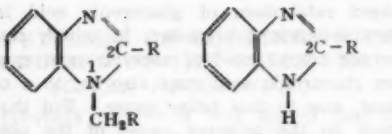
University Biochem. Lab., Madras-25, *July* 22, 1955.

K. SIVARAMA SASTRY.
P. S. SARMA.

1. Sure, B., Theis, R. M. and Harrelson, R. T., *J. Biol. Chem.*, 1939, **129**, 945.
2. Roy, S. C., Roy, S. K. and Guha, B. C., *Nature*, 1946, **188**, 238.
3. Skelton, F. R., *Proc. Soc. Exp. Biol. Med.*, 1950, **73**, 516.
4. Svirbely, J. L., *Am. J. Physiol.*, 1936, **116**, 446.
5. Bharani, S. P., Shah, Y. S. and Sreenivasan, A., *Proc. Ind. Acad. Sci.*, 1953, **37B**, 54.
6. Horowitz, H. H. and King, C. G., *J. Biol. Chem.*, 1954, **205**, 815.
7. Isherwood, F. A., Chen, Y. T. and Mapson, L. W., *Biochem. J.*, 1954, **56**, 1.
8. Jones, J. H. and Foster, C., *J. Nutr.*, 1942, **24**, 245.
9. Bessey, O. A. and King, C. G., *J. Biol. Chem.*, 1933, **103**, 687.
10. Bray, H. G., Humphris, B. G., Thorpe, W. V., White, K. and Wood, P. B., *Biochem. J.*, 1952, **52**, 419.
11. Mosbach, E. H., Jackel, S. S. and King, C. G., *Arch. Biochem.*, 1950, **29**, 348.

## REACTION BETWEEN *o*-PHENYLENE-DIAMINE AND AROMATIC ALDEHYDES

THE reaction between *o*-phenylene diamine and aldehydes in the absence of any specific oxidising agent was first studied by Ladenburg,[1,2] and later extended by Hinsberg.[3,4] When one mole of the diamine was allowed to react with two moles of aldehyde under acidic conditions, 'aldehydines' or 1 : 2-disubstituted benzimidazoles (I), occasionally accompanied by small amounts of 2-substituted benzimidazoles (II), were found to be formed. Both



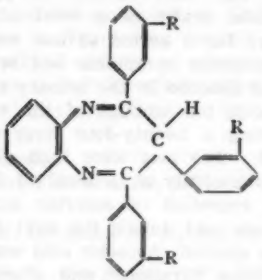
(I) (II)

types of compounds were reported in the case of *m*- and *p*-nitrobenzaldehydes,[4,5] whereas only compounds of type (I) were obtained with benzaldehyde,[1,6] *p*-hydroxybenzaldehyde,[7] vanillin,[6] and anisaldehyde.[2,7] Salicylaldehyde was considered to yield dialdimine.[6]

During our studies on the ease and mode of formation of heterocyclic ring systems containing nitrogen, we had occasion to re-investigate the action of certain aromatic aldehydes on *o*-phenylene diamine. In addition to the aldehydes already studied, the reaction between 2 : 4-dichlorobenzaldehyde, *p*-bromobenzaldehyde and *o*-nitrobenzaldehyde, and the diamine has now been investigated. The results are summarised in Table I.

The experimental procedure due to Hinsberg[3] has been modified by us to make an effective separation of the small amount of (II) from the major product (I), taking advantage of the difference in their basic nature. Applying this modification, it has now become possible to isolate both (I) and (II) in the case of benzaldehyde, anisaldehyde, *p*-bromobenzaldehyde, and the three isomeric nitrobenzaldehydes. However, *o*-nitrobenzaldehyde has been found to give the 2-substituted benzimidazole (II), as the principal product and 2 : 4-dichlorobenzaldehyde the compound of type (II) only. In the reaction with *o*- and *p*-hydroxybenzaldehydes and vanillin, exclusive formation of type (I) compounds has been noticed.

In the reaction with benzaldehyde, a third compound, which appears to be identical with compound (III) reported by Weil and Marcinkowska,[6] has been isolated. Further, an analogous compound, possibly having the structure (IV), has been obtained with *m*-nitrobenzaldehyde.



(III) R = H
(IV) R = $NO_2$

TABLE I

| No. | Aldehyde | Products isolated | | |
|---|---|---|---|---|
| | | 1 : 2-disubstituted benzimidazole | 2-substituted benzimidazole | Third product |
| 1 | Benzaldehyde | 1-benzyl-2-phenyl- | 2-phenyl- | Compound of m.p. 159 |
| 2 | Salicylaldehyde | 1-(*o*-hydroxybenzyl)-2-(*o*-hydroxyphenyl)-m.p. 220* | .. | .. |
| 3 | *p*-Hydroxybenzaldehyde | 1-(*p*-hydroxybenzyl)-2-(*p*-hydroxyphenyl)- | .. | .. |
| 4 | Vanillin | 1-(*p*-hydroxy-*m*-methoxybenzyl)-2-(*p*-hydroxy *m*-methoxyphenyl)- | .. | .. |
| 5 | Anisaldehyde | 1-(*p*-methoxybenzyl)-2-(*p*-methoxyphenyl)- | 2-(*p*-methoxyphenyl)- | .. |
| 6 | 2 : 4-Dichloro-benzaldehyde | .. | 2-(2 : 4-dichlorophenyl)- | .. |
| 7 | *p*-Bromo-benzaldehyde | 1-(*p*-bromobenzyl)-2-(*p*-bromophenyl)-m.p. 155* | 2-(*p*-bromophenyl)- | .. |
| 8 | *o*-Nitro-benzaldehyde | 1-(*o*-nitrobenzyl)-2-(*o*-nitrophenyl)-m.p. 120* | 2-(*o*-nitrophenyl)- | .. |
| 9 | *m*-Nitro-benzaldehyde | 1-(*m*-nitrobenzyl)-2-(*m*-nitrophenyl)- | 2-(*m*-nitrophenyl)- | Compound of m.p. 195 |
| 10 | *p*-Nitro-benzaldehyde | 1-(*p*-nitrobenzyl)-2-(*p*-nitrophenyl)- | 2-(*p*-nitrophenyl)- | .. |

* Compounds so far not reported in literature.

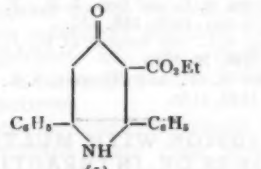
Full details of the investigation will be published elsewhere.

Dept. of Chemistry, N. V. SUBBA RAO.
Osmania University, C. V. RATNAM.
Hyderabad-7, *May* 29, 1955.

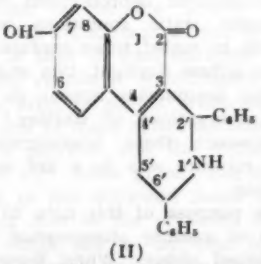
1. Ladenburg, A. and Englebrecht, T., *Ber*, 1878, **11**, 1653.
2. — and Rugheimer, L., *Ber*, 1878, **11**, 1656.
3. Hinsberg, O., *Ber.*, 1886, **19**, 2025; *Ibid.*, 1887, **20**, 1585.
4. — and Funcke, F. *Ber*, 1893, **26**, 3092; *Ibid.*, 1894, **27**, 2187.
5. Pinnow, J. and Wiskott, F., *Ber.*, 1899, **32**, 905.
6. Weil, S. and Marcinkowska, H., *Roczniki. Chem.*, 1934, **14**, 1312; *C. A.*, 1935, **29**, 6233.
7. Sevens, G. and Smets, G., *Bull. Soc. Chim. Belges.*, 1948, **57**, 32; *C. A.*, 1951, **45**, 568.

## FUSED HETEROCYCLIC COMPOUNDS FROM 3-ETHOXYCARBONYL-4-PIPERIDONES

THE piperidones[1] resulting from the condensation of ethyl acetoacetate with aldehydes and ammonia have an interesting structural feature. They have the grouping -CO.CH.COOEt
|
which is also present in ethyl acetoacetate and



(I)



(II)

which is responsible for the numerous applications of this ester in organic syntheses. Since many 4-piperidones having this grouping can be prepared by the method of Baliah *et al.*,[1] the synthesis of some interesting heterocyclic compounds can be readily accomplished through their use. The possibilities of such synthetic application are indicated in the present communication by the preparation of 1′ : 2′ : 5′ : 6′-tetrahydro-7-hydroxy-2′ : 6′-diphenylpyrido (3′ : 4′-3 : 4) coumarin (II) from resorcinol and 3-ethoxycarbonyl-2 : 6-diphenyl-4-piperidone (I).

*1′ : 2′ : 5′ : 6′-tetrahydro-7-hydroxy-2′ : 6′-diphenylpyrido (3′ : 4′-3 : 4) coumarin.*—To a mixture of 3-ethoxycarbonyl-2 : 6-diphenyl-4-piperidone (3·2 g.) and resorcinol (1·1 g.) was added concentrated sulphuric acid (5 c.c.) with stirring. After allowing to stand overnight, the product was poured into ice-cold water and the solid obtained was filtered off. The yield was 3·1 g. (84%). Recrystallisation from ethanol gave yellow prisms, m.p. 249-250° (decomp.). (Found: C, 77·8; H, 5·4. $C_{24}H_{19}NO_3$ requires C, 78·1; H, 5·2%.)

*7-Acetoxy-1′ : 2′ : 5′ : 6′-tetrahydro-2 : 6-diphenylpyrido (3′ : 4′-3 : 4) coumarin.*—To a solution of the foregoing compound (1·8 g.) in pyridine (2 c.c.) was added acetic anhydride (2 c.c.). After shaking, the mixture was kept overnight. Dilution with water gave the *acetyl* derivative (1·7 g.; 82%). The compound crystallised from pyridine as colourless prisms, m.p. 307-09°. (Found: C, 75·6; H, 4·9. $C_{26}H_{21}NO_4$ requires C, 75·9; H, 5·1%.)

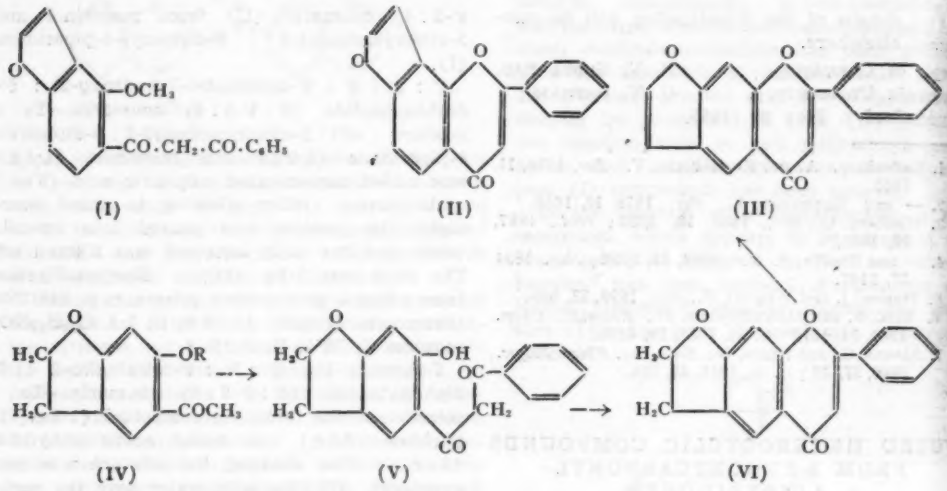
Dept. of Chemistry, V. BALIAH.
Annamalai University, A. EKAMBARAM.
Annamalainagar, *June* 17, 1955.

1. Baliah, V., Gopalakrishnan, V. and Govindarajan, T. S., *J. Ind. Chem. Soc.*, 1954, **31**, 832.

## SYNTHESIS OF FURANO-(3′ : 2′ : 6 : 7)-FLAVONE

RECENT investigations have revealed the presence of furano-flavones and related compounds in the plant kingdom. For example, karanjin has been known to be the active principle of Pongamia oil,[1] while it accompanies pongapin, 3′ : 4′-methylene dioxy karanjin, in the root bark of *Pongamia pinnata* (L.) Merr.[2] from which two more furano-flavones of unknown constitution were isolated. Pongamol (I) from Pongamia oil[3] is unique as it is the only furano-diketone so far known to occur in nature. Further, from the root bark of *Tephrosia lanceolata* Grab., Rangaswami and Sastry[4] reported the isolation of three compounds, one of which was identified to be pongamol (I) and the other, the furano-flavone (II) derived from I. It is interesting to note that all these compounds possess only the angular structure.

In connection with a synthetic programme of work on furano-pyrones[5] we had occasion to synthesise the isomeric linear furano-flavone (III) following the scheme given below,




The benzoate (m.p. 113-14°; IV, R = $CO.C_6H_5$) of 5-acetyl-6-hydroxy coumaran[6] (IV, R = H) suffers migration when heated at 35-40° in presence of pyridine and potassium hydroxide for four hours. The resulting diketone (V) (m.p. 110-11°) crystallises from benzene-petroleum ether as bright yellow needles and gives a bright green ferric reaction. (Found: C, 72·2; H, 5·1; $C_{17}H_{14}O_4$ requires C, 72·4 and H, 5·0%.) When boiled with glacial acetic acid containing a few drops of concentrated hydrochloric acid, the diketone undergoes ring closure giving the dihydrofurano-(3′ : 2′ : 6 : 7)-flavone (VI). The latter crystallises from alcohol as pale yellow prismatic plates (m.p. 202-03°). It gives pale yellow solution in concentrated sulphuric acid with intense blue fluorescence. (Found: C, 77·0, H, 4·3; $C_{17}H_{12}O_3$ requires C, 77·3 and H, 4·5%.)

Dehydrogenation of the dihydro furano-flavone (VI) is effected by refluxing it in diphenyl ether with 30% Pd-C catalyst (Linstead's catalyst[7]). The furano-(3′ : 2′ : 6 : 7)-flavone (III) is obtained as pale yellow bundles of needles (m.p. 168-69°) from alcohol. (Found: C, 77·6; H, 4·1; $C_{17}H_{10}O_3$ requires C, 77·9 and H, 3·8%.) It exhibits only a yellow colouration with cold concentrated sulphuric acid which deepens when warmed in contrast to the angular furano-flavone (II) which gives a blue colour.[8]

S. K. Pavanaram.
L. Ramachandra Row.

Dept. of Chemistry,
Andhra University,
Waltair, *May* 10, 1955.

1. Limaye, D. B., *Rasayanam*, 1936, 1; 1937, 119.
2. Ramachandra Row, L., *Austr. J. Sci. Res.*, 1952, **5A**, 754.
3. Narayanaswami, S., Rangaswami, S. and Seshadri, T. R., *J. Chem. Soc.*, 1954, 1871.
4. Rangaswami, S. and Sastry, B. V. R., *Curr. Sci.*, 1955, **24**, 13.
5. Pavanaram, S. K. and Row, L. R., *J. Sci. Industr. Res.* (India), 1955, **14B**, 157.
6. Horning, E. C. and Reisner, D. B., *J. Amer. Chem. Soc.*, 1948, **70**, 3619.
7. Linstead, R. P. and Thomas, S. L. S., *J. Chem. Soc.*, 1940, 1130.

## DIFFUSION WITH MULTIPLE ZONES OF INTERACTION

When unmasticated deproteinised rubber is in contact under static conditions with carbon tetrachloride in sealed tubes containing air and exposed to diffuse daylight, two sharp horizontal diffusion boundaries appear in accordance with the observations of Hartley.[1] On continued exposure these boundaries disappear when the mixture sets to a gel and becomes homogeneous.

It is the purpose of this note to record the occurrence of another phenomenon besides the one mentioned above. When these tubes are exposed to diffused daylight for a period exceeding 72 hours several rings are observed. These rings start from the boundary separating the concentrated solution from the rubber and are spaced more or less equidistant in the rubber phase. The last pair of rings in the rubber however are separated by a greater distance from the rest. These rings are shown in Fig. 1.

The above rings persist in the gel even on continued exposure and are clearly visible on

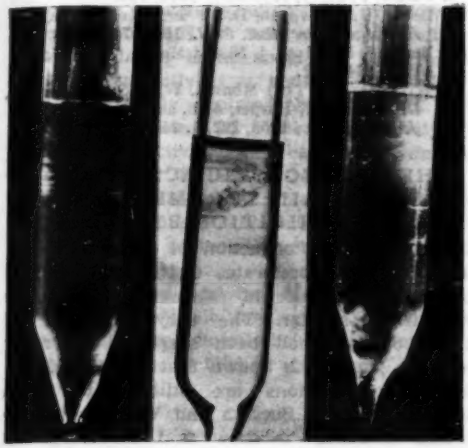


FIG. 1 FIG. 2 FIG. 3

the solid gel when it is pushed out of the tube. The appearance of these distinct rings indicates a change in the composition of the material in the narrow zones appearing as rings.

Hill[2] and Hermann[3] have discussed the displacement of an interaction boundary formed inside a polymer by the reaction of the diffusant with the substances found in the polymer. Recently Gordon[4] has also considered the interaction of a reagent with fixed reaction sites in a polymer.

The present investigation reveals the occurrence of multiple static rings when rubber-carbon tetrachloride systems are exposed to diffused daylight or to the action of X-rays (Fig. 2). These static rings do not appear when the system is kept in total darkness (Fig. 3).

From these results it is concluded that activated zones arise in rubber when subjected to irradiation and in these activated zones reaction between the polymer and the diffusant ($CCl_4$ or dissolved air) takes place. The diffusant is immobilized in the activated zones by the reaction giving rise to the observed rings. Further, these rings are in addition to ordinary diffusion boundaries and differ from them in that they do not disappear with time, whereas diffusion boundaries do so. Full details of the experiment will be published elsewhere.

National Chemical Lab., Poona-8, *May* 30, 1955. C. S. RAMAKRISHNAN. J. B. PANDE.

1. Hartley, G. S., *Trans. Farad. Soc.*, 1946, **42B**, 6.
2. Hill, A. V. *Proc. Royal. Soc.*, 1928, **104B**, 39.
3. Hermans, J. J., *J. Colloid Science*, 1947, **2**, 387.
4. Gordon, M., *Proc. Royal Soc.*, 1955, **228A**, 397.

## VITAMIN $B_{12}$ AND RICE MOTH LARVAE

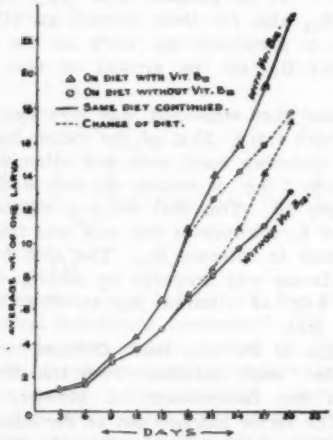
THE vitamin $B_{12}$ requirement of animals and birds has been studied; but no data appear to be available about its requirement by insects. The rice moth larvæ (*Corcyra cephalonica* Staint.) shows a striking resemblance to the higher animals in their requirement of the B vitamins.[1-5] It is possible that they require vitamin $B_{12}$ also for their normal growth. In this note is presented our work on the effect of vitamin $B_{12}$ on the growth of rice moth larvæ.

The basal diet employed was soyabean meal used for the rats.[6] 25 g. of the ration containing corn soyabean meal, salts and vitamins was mixed with 1·0 g. of sesame oil and 0·25 g. of shark liver oil. This diet did not support the growth of *L. leichmanni* 313 and was taken to be deficient in vitamin $B_{12}$. The diet for the 'control' larvæ was prepared by adding a solution of 5 $\mu$g. of vitamin $B_{12}$ to 25 g. of the deficient diet.

The eggs of the rice moth *Corcyra cephalonica* Staint. were obtained from the Entomologist to the Government of Mysore, South India. The larvæ hatched out of the eggs were maintained on a whole wheat flour for ten days and then used in the experiments.

In the preliminary experiments, two groups of ten larvæ each were used. They had nearly the same average weight at the start of the experiment. They were kept in separate glass petridishes, at the room temperature (27 to 28·5° C.) and the weights of the larvæ were recorded twice a week. It was observed that the larvæ maintained on corn-soyabean meal supplemented with vitamin $B_{12}$ showed a better growth than those receiving the same diet without vitamin $B_{12}$. The experiment was repeated with two groups of twenty larvæ each. After 15 days the deficient larvæ were separated into 2 groups of approximately the same average weight and one group was transferred to the diet containing vitamin $B_{12}$ while the other was continued on the same diet. Similarly the control larvæ were also separated into two groups one of which was transferred to the deficient diet and the other was continued on the same diet. The weights were recorded twice a week. The results represented in Graph I clearly indicate that the larvæ show a much better growth when fed the diet supplemented with vitamin $B_{12}$ and the weight of larvæ shows a decrease when they are transferred to vitamin $B_{12}$ deficient diet.

Beiler *et al.*[7] have reported the preparation of an 'antagonist of vitamin $B_{12}$ by the oxidation of the vitamin with $H_2O_2$ in the presence of concentrated HCl. This substance has been found by them to have an inhibitory effect on the micro-organism *L. leichmanni*. The 'antagonist' is however reported to have no inhibitory effect on the gowth of rats.[8]




The effect of the 'vitamin $B_{12}$ antagonist' was studied on the rice moth larvæ. The antagonist was prepared by the method of Beiler *et al.*[7] and mixed with the vitamin $B_{12}$ deficient diet. The rice moth larvæ were fed this diet and the growth was compared with that obtained when they were maintained on the $B_{12}$ deficient diet and the diet containing vitamin $B_{12}$. The results obtained indicate that the 'antagonist' does not probably have an inhibitory effect on the growth of rice moth larvæ. The larvæ fed antagonist show only a slightly better growth when fed the diet without vitamin $B_{12}$. A detailed account of this work will be published elsewhere.

We wish to express our thanks to the Trustees, Lady Tata Memorial Trust, Bombay, for the award of a Research Scholarship to one of us (R. V. B.).

Dept. of Biochemistry, Institute of Science, Bombay-1, *May* 10, 1955.

R. V. Bhagwat.
Kamala Sohonie.

1. Swamy, B. G. L. and Sreenivasaya, M., *Curr. Sci.*, 1939, **8**, 365.
2. Sarma, P. S., Swamy, B. G. L. and Sreenivasaya, M., *Ibid.*, 1942, **11**, 332.
3. Bhagvat, K. and Sarma, P. S., *Ind. J. Med. Res.*, 1943, **31**, 173.
4. Sarma, P. S., *Ibid.*, 1944, **32**, 117.
5. Sarma, P. S., *J. Med.Res.*, 1944, 149.
6. Lewis, U. J., Tappan, D. V. and Elvehjem, C. A., *Proc. Soc. Expt. Biol. Med.*, 1950, **74**, 568.
7. Beiler, J. M., Moss, J. N. and Martin, G. J., *Science*, 1951, **114**, 122.
8. Williams, J. N. (Jr.), Monson, W. J., Sreenivasan, A., Dietrich, L. S., Harper, A. E. and Elvehjem, C. A., *J. Biol. Chem.*, 1953, **202**, 1, 151.

## THE PROTEOLYTIC ACTIVITY OF RABBIT BRAIN THROMBOPLASTIN AND ITS INHIBITION BY HEPARIN

The exact mode of action of brain thromboplastin, which accelerates clotting of blood or plasma in presence of calcium, has not been established so far. The enzymic nature of thromboplastin had been suspected by many workers since it is known that brain thromboplastin preparations are still active when diluted to $10^{-5}$. Seegers and Ware[1] have collected evidence to show that thromboplastin acts catalytically and is not consumed during the conversion of prothrombin to thrombin though Mertz, Seegers and Smith[2] had earlier reported that thromboplastin is consumed during blood coagulation. There has been indirect evidence in the literature to suggest the participation of proteolytic enzymes in blood coagulation. Eagle and Harris[3] and Ferguson[4] have found that trypsin, papain and other proteolytic enzymes could form thrombin from pro-thrombin. Macfarlane and Pilling[5] and Macfarlane[6] have shown that soya-bean trypsin inhibitor inhibits the action of brain thromboplastin.

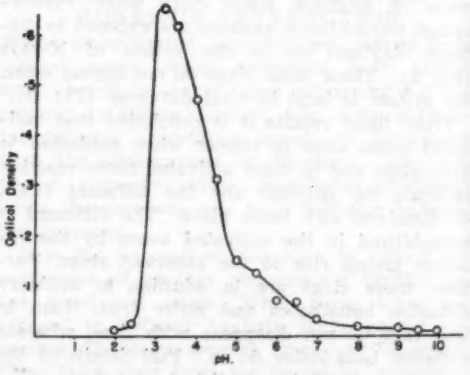



Fig. 1. Proteolytic activity of Rabbit Brain thromboplastin.

The proteolytic activity of a 0·5% rabbit brain thromboplastin suspension prepared according to Quick[7] was measured on heat denatured horse hæmoglobin substrate according to the method of Anson[8] at short intervals of

pH between 2 and 10 using Veronal-acetate-phosphate universal buffer. Fig. 1 shows that the optimum pH for the proteolytic action of thromboplastin is at about pH 3·2. It had hardly any activity at neutral or alkaline pH which probably explains the failure of earlier workers to detect its proteolytic activity. The proteolytic activity was completely destroyed on heating for 15 minutes at 100° C.

Heparin which inhibits blood coagulation was then tested to see whether it has any inhibitive action on proteolytic activity. It was found that purified heparin (100 units/mg.) inhibited the proteolytic activity of thromboplastin at pH 3·2. The inhibition was of a competitive type as judged from the results in Fig. 2. Details will be published elsewhere.

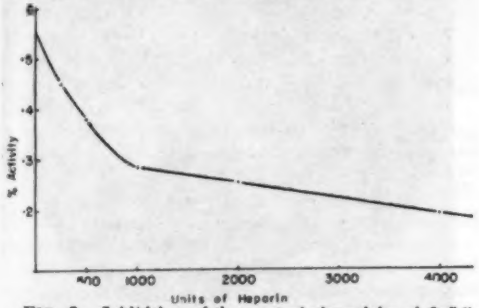



FIG. 2. Inhibition of the proteolytic activity of 0·5% Rabbit Brain thromboplastin with different concentrations of heparin.

The authors wish to thank Dr. P. M. Wagle and Dr. A. K. Hazra for their keen interest in the work. The authors are grateful to the Connaught Medical Research Laboratories, Toronto, for a generous gift of heparin, and to the Raptakos Medical Research Board for the award of a fellowship to Mrs. Rao.

(Mrs.) Shanta S. Rao.
Dr. S. S. Rao.

Dept. of Antitoxins & Sera,
Haffkine Institute,
Bombay-12, *July* 12, 1955.

1. Seegers, W. H. and Ware, A. G., "Blood Clotting and Allied Problems," *First Conference of Josiah Macey Foundation*, p. 64.
2. Mertz, E. T., Seegers, W. H. and Smith, H. P., *Proc. Soc. Exp. Biol., N. Y.*, 1939, **42**, 604.
3. Eagle, H. and Harris, T. N., *J. Gen. Physiol.*, 1937, **20**, 543.
4. Ferguson, J. H., "Blood Clotting and Allied Problems," *3rd Conference of Josiah Macey Foundation*, 1949.
5. Macfarlane, R. G. and Pilling, J., *Lancet*, 1946, **1**, 888.
6. —, *J. Physiol.*, 1947. **106**, 104.
7. Quick, A. J., *The Physiology and Pathology of Hemostasis* (Philadelphia, Lea and Febiger), 1951.
8 Anson, M. L., *J. Gen. Phys.*, 1938, **22**, 79.

## THE PARIETAL ORGAN IN *CALOTES VERSICOLOR* (DAUD.)

The roof of the diencephalon of lizards is produced into median outgrowths namely, the paraphysis in front, the dorsal sac in the middle, the parietal organ (the pineal eye) and the epiphysis behind.[1] Recently it has been shown that the paraphysis is the centre of accumulation of neurosecretory products, coming from the hypothalamic centres, from where they diffuse into the blood stream.[2,3] The dorsal sac is a space continuous with the diacœl. The epiphysis is a glandular structure of endocrine function commonly known as the pineal body[4] and the parietal organ is generally attached to its anterior portion forming a vesicular structure lying in the parietal foramen or just below it.

According to Sedgwick,[5] the parietal organ in *Calotes* is stated to be quite separate from the brain unlike in many other lizards where it remains connected with the brain by a cord of tissue. In various sections of the brain of *Calotes versicolor* (Daud.) examined by me, it was seen that a cord of tissue is present connecting the parietal organ with the diencephalon (Fig. 1). This solid cord of tissue (Fig. 1, c)

FIG. 1. Sagittal section of the brain of *Calotes versicolor* (Daud.) to show the parietal organ and associated structures. Bouin and Gomori's chrome-hæmatoxylin-phloxin. The solid cord of tissue (*c*) connecting the parietal organ with the epiphysis (*e*) is distinctly seen. *n*, paraphysis, *P*, capillary plexus; *s*, dorsal sac; *w*, wall of parietal organ. Approximately, × 90.

is bent and connected with the roof of the diencephalon just in front of the reduced and glandular epiphysis which forms a small hillock in the roof of the diencephalon. The vasicular parietal organ is ovoid measuring

about 650 $\mu$ in length with its walls composed of columnar cells with layers of nuclei. The organ is enveloped by a thick capillary plexus. The entire organ is separated from the paraphysis by a narrow space representing the dorsal sac.

A detailed study of the relations of the parietal organ, the neurosecretory centre of the paraphysis and the endocrine epiphysis is in progress.

Dept. of Zoology, V. ANANTHANARAYANAN.
University College,
Trivandrum, *June* 17, 1955.

1. Romer, A. S., *Vertebrate Body*, Philadelphia, 1950, 575.
2. Scharrer, E. and B., *Handb. mikr. Anat. Menschen*, 1954, **6**, 953.
3. Ananthanarayanan, V., *Zeits. Zellf.* 1955 (in press).
4. Grollman, A., *Essentials of Endocrinology*, Philadelphia, 1947, 137.
5. Sedgwick, A., *A Student's Text Book of Zoology*, London, 1932, **2**, 344.

## ENZYME COMPLEX OF THE CORPUS ALLATUM OF THE FEMALE *IPHITA LIMBATA* STAL.

A PRELIMINARY note on the structure and changes of the corpus allatum of the female plant bug *Iphita limbata* Stal. (Pyrrhocoridæ : Hemiptera) was published by the author.[1] No work has so far been done on the enzyme complex of the neurosecretory system of invertebrates.[2] The corpus allatum, which forms part of the pars intercerebralis-cardaicum-allatum system of the neurosecretory endocrine organs, shows marked changes in the secretory activity as the female starts mating and eggs begin to develop, reaching the maximum size as the insect becomes gravid. After oviposition the corpus allatum shrinks slowly.

This enlargement of the corpus allatum is also associated with an increase in the development of the enzyme content of the gland. Two enzymes, *viz.*, acid phosphatase and succinic dehydrogenase, gradually increase in amount as the corpus allatum enlarges. The maximum concentration occurs in the gravid female.

Gomori's technique as recommended in his recent book[3] has been employed for the study of acid phosphatase, control material being inactivated by either Lugol's iodine or boiling water. Incubation for six hours at 37° C. gave the best results. Seligman and Rutenberg's[4] method using blue tetrazolium and Shelton and Schneider's (Pearse[5]) method using neotetrazolium were used for the study of succinic dehydrogenase, control material being incubated with sodium malonate added to the mixture. Freshly dissected corpora allata have been used in the studies.

In the newly moulted female imago, the corpus allatum shows the nuclei as seats of acid phosphatase. In that of the female which is mating and where eggs are developing, besides the nuclei there are granules indicating sites of

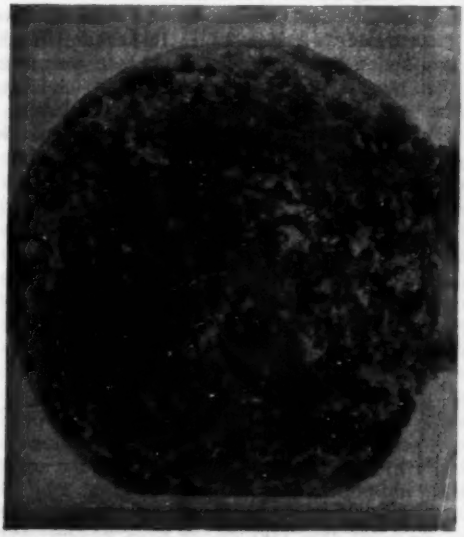


FIG. 1. Corpus allatum of the female *Iphita limbata* Stal., twelve hours after oviposition, to show the sites of acid phosphatase activity. The dark rounded bodies are the nuclei, the black patchy regions and granules are localisations of the enzyme in the cytoplasm. Incubation time 370 minutes. Approximately, × 75.

acid phosphatase in the cytoplasm. In the gravid female, the black granular material is distributed in the cytoplasm in large quantities, showing a high concentration of the enzyme. After oviposition, the enzyme content of the gland remains practically the same (Fig. 1).

Newly emerged imagines show practically no positive indication of succinic dehydrogenase in the corpus allatum. But in the mating female where the corpus allatum is enlarging, well-defined particles indicating sites of succinic dehydrogenase activity make their appearance. A large number of blue diformazan particles and few monoformazan granules occur in the cytoplasm, especially along the margin of the gland and near the allatic nerve. In the gravid female, with highly distended abdomen and mature eggs, the cytoplasm shows very high concentrations of the enzyme, demonstrable by both the methods. There are

myriads of blue (or purple in Shelton and Schneider's method) granules in the cytoplasm and where the entire gland is incubated, concretions of these granules occur as large and conspicuous colloids (Fig. 2). The nuclei appear

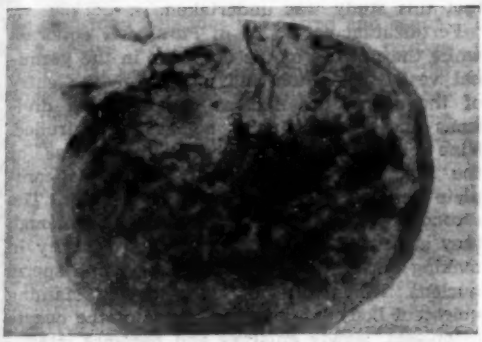


FIG. 2. Corpus allatum of the gravid female, showing sites of succinic dehydrogenase activity. Shelton and Schneider's method. Incubation time 40 minutes. The colour developed in three minutes. Approximately, ×55.

as transparent vesicles. There is a marked fall in the enzyme content as oviposition occurs.

More detailed investigations on the cyclical development of the enzymes in the corpus allatum and the relationship between the dehydrogenase system and the oxidases in the blood of the female, are in progress.

I am indebted to Prof. C. M. Francis, Medical College, Trivandrum, for the gift of tetrazolium used in this study.

Dept. of Zoology, K. K. NAYAR.
University College,
Trivandrum, *June* 3, 1955.

1. Nayar, K. K., *Curr. Sci.*, 1953, **22**, 241.
2. Scharrer, E. and B., *Handb. mikr. Anat. Menschen*, 1954, **6**, 980.
3. Gomori, G., *Microscopic Histochemistry*, Chicago, 1952, 136.
4. Seligman, A. M. and Rutenberg, A. M., *Science*, 1951, **113**, 317.
5. Pearse, A. G. E., *Histochemistry*, London, 1953, 215.

## THE CERVICAL EXTENSIONS OF THE THYMUS IN *LORIS LYDEKKERIANUS* (CABR.) AND THEIR SIGNIFICANCE

LORISOIDS exhibit a number of primitive features of anatomy. Some authors[6,7] consider them as truly primitive, while others[1,3,11] regard them as secondary simplifications consequent on sedentary habit. While examining the thymus of *Loris lydekkerianus*, it was discovered that in the embryo of this prosimian, the thymus extended into the cervical region and was lymphoidal, thus offering a condition which must be regarded as primitive.

The thymus of *Loris lydekkerianus* is well developed in the fœtus and also in young individuals. It consists, on each side, of a main part, located in the thorax, which gives off anteriorly, a cervical extension reaching up to the thyroid gland. This extension is made up of 5-6 distinct lobes. Each lobe is lymphoidal in nature, is enclosed by a thin compact capsular wall and shows a clear demarcation between cortex and medulla (Fig. 1). The cortex is

FIG. 1. Sagittal section of the thymus of *Loris* embryo (CR length=30 mm.) showing its lobulated lymphoidal cervical extension, × 11. *c*=Cortex; *cl*=Cervical thymus; *m*=Medulla; *t*=Thoracic thymus.

made of thymocytes, while the medulla consists of reticular cells, thymocytes, basophilic granulocytes and simple plasmodial Hassall's corpuscles.

The lymphoidal nature of the cervical thymus in *Loris lydekkerianus* has great significance. In a higher mammal like *Loris* it is an indication of the persistence of a primitive character. It is well known that in lower vertebrates[2,8,9] the thymus is lymphoidal in embryonic and larval conditions and is jugular in position. But in mammals, due to elongation of the cervical region, the main portion of the thymus migrates to the thorax leaving remnants of thymic tissue in the cervical region. Generally this cervical portion is a simple epithelial cord and is not lymphoidal in nature (except in ungulates[10]) and disappears very early.[4,5] The persistence of a well developed lymphoidal cervical thymus in *Loris lydekkerianus* embryo and young is indicative of a

truly primitive condition which we believe is primary and not due to a secondary simplification. Besides, the non-hyalinized Hassall's corpuscles of *Loris lydekkerianus* recall rather the multinucleated plasmodial masses of the reptilian thymus[9] than the hyalinized corpuscles of Hassall of either guinea-pig or man, offering yet another feature of the primitive organization of the thymus in this form.

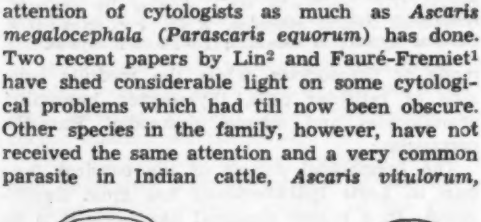
B. A. GHULAM AHMAD.
M. APPASWAMY RAO.

Dept. of Zoology,
Central College,
Bangalore, *July* 1, 1955.

1. Assheton, R., *Q.J.M.S.*, 1910, **54**, 57.
2. Fabrizio, M. and Charipper, H. A., *J. Morph.*, 1941, **68**, 179.
3. Flynn, T. T., *Q.J.M.S.*, 1923, **67**, 54.
4. Fox, H., *Amer. J. Anat.*, 1908, **8**, 187.
5. Hamilton, W. J., Boyel, J. D. and Mossman, H. W., *Human Embryology*, Heffer, Cambridge, 1945.
6. Hill, J. P., *Phil. Trans. Roy. Soc.*, Lond., 1932, **221**, 45.
7. Hill, W. C. O., *Spolia Zeylonica*, 1933, **18**, 89.
8. Rao, M. A., *J. Zool. Soc. Ind.*, 1954, **6**, 59.
9. —, *Proc. Nat. Inst. Sci. Ind.*, 1955, **21**, 10.
10. Sandberg, E., *Acta Soc. Med. Upsala*, 1949, **54**, 269.
11. Wislocki, J. B. and Hartman, C. G., *Bull. Johns Hopkins Hosp.*, 1929, **44**, 73.

## CHROMOSOMES IN OOGENESIS OF *ASCARIS VITULORUM*

PERHAPS no other species has received the attention of cytologists as much as *Ascaris megalocephala* (*Parascaris equorum*) has done. Two recent papers by Lin[2] and Fauré-Fremiet[1] have shed considerable light on some cytological problems which had till now been obscure. Other species in the family, however, have not received the same attention and a very common parasite in Indian cattle, *Ascaris vitulorum*, has found no place in cytological literature. Makino[3] makes no mention of the chromosomes of this species in his Atlas. And no account of gametogenesis, fertilization or the striking phenomena so characteristic of cleavage divisions in *Parascaris equorum* have been described or looked for. It is with the idea of extending our knowledge of members of Ascaridæ that this study was undertaken.



FIGS. 1–3. Fig. 1. Oocyte of *Ascaris vitulorum* showing the polar view of first metaphase. Nine bivalents are seen. The sperm nucleus is in the centre, × 315. Fig. 2. Oocyte in first anaphase. Side view, × 315. Fig. 3. Oocyte showing a tripolar spindle. First division, × 315.

Fertilization occurs as in *Parascaris equorum* while the nucleus of the oocyte is in the germinal vesicle condition and only after the entry of the sperm the nucleus completes its divisions and the two polar bodies are extruded. Nine bivalents are noticed in metaphase of the first division. Soon the division is complete and the first polar body is cast out. The second division follows soon after and though they are much smaller, there is no difficulty in making out the nine chromosomes. The sperm nucleus, which till now is a deeply staining quiescent body lying in the centre of the oocyte cytoplasm, slowly enlarges and becomes irregular in outline as the second meiotic division goes under way. The cleavage divisions have not yet been examined thoroughly and will be described in a separate communication.

Multipolar spindles are quite common in the first meiotic division and while it is difficult to account for them, it seems reasonably certain that they ultimately degenerate.

Grateful thanks are due to Dr. N. Krishnaswamy of the Agricultural Research Station, Coimbatore, for the gift of this material and to Dr. B. R. Seshachar for guidance and encouragement.

Dept. of Zoology, K. H. NEELAKANTAIYA.
Central College,
Bangalore, *July* 5, 1955.

1. Fauré-Fremiet, E., *Exp. Cell Research*, 1954, **1**, 153.
2. Lin, T. P., *Chromosoma*, 1954, **6**, 175.
3. Makino, S., *An Atlas of the Chromosome Numbers in Animals*, Iowa State College Press, 1951.

## ON THE BONY-PALATE OF THE INDIAN HAWK, *FALCO JUGGER* (GRAY)

HUXLEY[2] based his classification of birds on the disposition of the various bones of the palate. He grouped vultures, hawks, and eagles along with other Raptores diurnæ as Gypætidæ, a sub-group of Aetomorphæ, which is equivalent to the "Raptores" of Cuvier. The disposition of the palatal constituents of the Indian hawk has undergone a modification different from that in other birds of the group. I have, therefore, ventured to study the bony-palate of *Falco jugger* (Gray) in detail.

The maxillo-palatine apparatus formed by the union of the paired, oblong, plate-like

maxillo-palatines contributes to the formation of the anterior part of the palate. The maxillo-palatines are fully ossified and meet in the middle line thereby completely obliterating the intervening space, a contrast to similar spongy and narrow structures, reported in other Raptores diurnæ.[2]

The elongated palatines are paired and spatulate in shape. They form the greater portion of the palatal roof of the mouth and border the choanæ or inner narial openings. Their posterior parts or "bodies" are boat-like in shape and are transversely expanded. Anteriorly the bodies of palatines pass into narrow "ascending processes". The inner margins of the upper half of these processes abut against the maxillo-palatine of the corresponding side.

The posterior end of the palatine and the anterior end of the pterygoid, besides articulating with one another articulate with a small, distinct, triangular bone, the basipterygoid which has, hitherto, been unrecorded in Gypætidæ. This bone may be compared to the so-called "mesopterygoid" of Parker[3] and the "hemipterygoid" of Pycraft.[4]

The pterygoids are rod-like structures obliquely directed towards the ventral head of quadrate, the condylus mandibularis. In contrast to what is generally met with in most desmognathous skulls, the anterior ends of the pterygoids and the posterior ends of the palatines do not articulate directly with the basisphenoidal rostrum, but through the basipterygoids which, though sessile, have fibrous connections with the basisphenoidal rostrum. In a few other cases Broom[1] has noted cartilaginous connections also.

The basisphenoidal rostrum lies between the pterygoids. Anteriorly it is narrow and its posterior end along with the anterior end of the basisphenoid forms a transversely directed ridge.

Intervening between the two palatines there is a narrow parasphenoid (basitemporal of Parker). It takes part in the formation of a cartilaginous-*cum*-bony orbital septum. It is interesting to note that the parasphenoid and vomer are quite distinct bones. The presence of the two distinct bones is a primitive feature. The vomer has been recorded as being completely absent or vestigial in desmognathous skulls.[2] But it has been observed as a prominent slender bone extending from the posterior margin of the maxillo-palatine shelf to the anterior margin of the parasphenoid. The vomer typically extends between the internal nostrils and forms their postero-medial boundary. In contradistinction to Huxley's observation, in the forms where it exists, the vomer is not tapering but ends bluntly at both the ends.

Thus an osteocranic maxillo-palatine, together with a small basipterygoid, a separate vomer and parasphenoid are features in which *Falco jugger* (Gray) has specialised, and from a comparative standpoint, in its palatal structure it is different from other members of its group. A unique factor to be noted in this case is the tendency towards retention of the more primitive cranial characters.

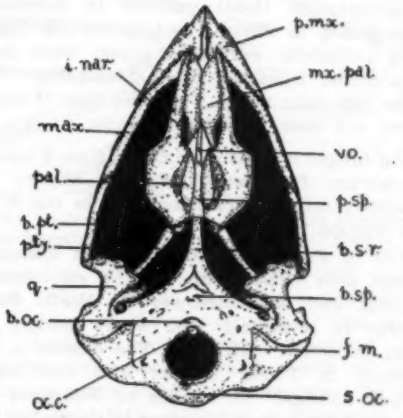



FIG. 1. Ventral view of the skull of *Falco jugger* (Gray) showing the bony-palate, × 1. *b.oc.* = basioccipital; *b.pt.* = basipterygoid; *b.sp.* = basisphenoid; *b.sr.* = basisphenoidal rostrum; *f.m.* = foramen magnum; *i.nar.* = internal nare; *mx.* = maxilla; *mx.pal.* = maxillo-palatine; *Oc.c.* = Occipital condyle; *pal.* = palatine; *p.mx.* = premaxilla, *p.sp.* = parasphenoid; *pty.* = pterygoid; *q.* = quadrate; *S.Oc.* = Supraoccipital; *Vo.* = Vomer.

A detailed paper on the cranial morphology of this bird will be published shortly.

I am thankful to Dr. P. N. Mathur for his kind guidance and supervision and to Principal V. V. John for research facilities and to Sri. Jagdish Prasad for his helpful criticism.

Dept. of Zoology, V. D. MATHUR.
Govt. College, Ajmer,
*May* 16, 1955.

1. Broom, R., *Proc. Zool. Soc.*, London, 1922, 455.
2. Huxley, T. H. *Ibid.*, 1867, 415.
3. Parker, W. K., *Trans. Linn. Soc.*, London, 1875, **1**, 1.
4. Pycraft, W. P., *Trans. Zool. Soc.*, London, 1900, **15**, 149.

## *FUSARIUM* WILTS OF WATERMELON AND PEAS IN BOMBAY STATE

*Wilt of Watermelon.*—A wilt disease of watermelon (*Citrullus vulgaris* Schrad.) causing serious damage was recorded in January 1953 at Dorli near Kalyan in Thana District. Roots of affected plants showed the characteristic browning of vascular system and a microscopic examination showed presence of fungus hyphæ in the xylem vessels. A species of *Fusarium* was consistently isolated from roots of diseased vines and the fungus proved pathogenic to watermelon (local variety) in inoculation experiments at Poona. Isolates of the fungus from artificially inoculated plants were indistinguishable from the original cultures. This is the first time that a *Fusarium* wilt of watermelon has been recorded in India.

The fungus is indistinguishable from *Fusarium oxysporum* f. *niveum* (E.F.S.) Snyder and Hansen causing watermelon wilt in the U.S.A. and Europe.

*Wilt of Peas.*—A destructive wilt disease of garden peas (*Pisum sativum* L.) was recorded at Wai and Mahableshwar in North Satara District in November 1952 where garden peas is an important cash crop. The disease is now common in Poona District also and causes serious damage. A species of *Fusarium* was isolated from wilted pea vines in December 1952 and proved pathogenic to pea in infection experiments carried out at Poona. A detailed study of the fungus showed that it was indistinguishable from *Fusarium oxysporum* f. *pisi* (Linford) Synder and Hansen, race 1, causing wilt of peas in the U.S.A.

The following commercial varieties of peas resistant to wilt were obtained from the U.S.A. and Holland and tested at Poona in a glasshouse against the fungus causing wilt of peas in Bombay State: Alaska, Wisconsin Perfection, Pride, Perfected Wales and New Era from U.S.A. and Alaska, Celsior, Korza, Vares and Zelka from Holland. All these varieties proved susceptible to the Bombay strain of the fungus. It is, therefore, possible that the Bombay fungus is a biotype of the American pea wilt fungus, though conclusive evidence has not yet been obtained. More work on this problem is in progress at Poona.

Plant Pathological Lab., V. P. Bhide.
College of Agriculture, R. K. Hegde.
Poona-5, *April* 19, 1953. R. S. Sukapure.

## ANTIBIOTIC PRODUCTION BY *FUSARIUM VASINFECTUM* ATK. IN SOIL

Evidence indicating antibiotic production in soils, has so far been presented only in the case of non-pathogenic soil fungi.[1–4] The present note reports production of an antibiotic in soil by a plant pathogenic soil fungus, *viz.*, *Fusarium vasinfectum* Atk. Earlier work[5,6] has already shown that this fungus produces fusaric acid, a phytotoxin, also capable of antibiosis, *in vitro*.

The soil (pH 8·1 and moisture-holding capacity 47·5%) used was collected from the Madras University Botany Field Laboratory Garden. 90 g. of sieved soil taken in 250 ml. Erlenmeyer flasks were given 10 g. of the following amendments: glucose, filter-paper, stubbles of cotton plants (*Gossypium arboreum*), green leaf choppings (*Glyricidia maculata*), farmyard manure and oats. Distilled water was added to each flask to keep the moisture level at 60%. After sterilisation at 20 lb. steam pressure for an hour and a half, the flasks were inoculated with spore suspensions of *F. vasinfectum* and incubated at room temperature (28–32° C.). The uninoculated series served as control. At regular intervals, cultures in replicates of four were removed with minimum amount of distilled water and centrifuged at 3,000 r.p.m. for 45 minutes.[3] The extracts thus obtained were tested for final pH before assaying for antibiotic potency in terms of fusaric acid equivalent.[6]

Table I

*Production of antibiotic (expressed as μg. fusaric acid equivalent/g. of soil) in sterilised soil with different amendments*

| Age in days | None | Glucose | Filter paper | Stubbles | Farmyard manure | Green leaf | Oats |
|---|---|---|---|---|---|---|---|
| 7 | nil | nil | nil | nil | nil | nil | 1·25 |
| 14 | nil | nil | nil | traces | nil | 2·30 | 7·90 |
| 21 | nil | nil | nil | nil | nil | 2·90 | 2·19 |
| 28 | nil | nil | nil | nil | nil | 2·60 | 2·00 |

The results in Table I indicate that *F. vasinfectum* produces this antibiotic in sterilised and amended soil (+ green leaf and oats), the maximum quantity produced (7·9 μg./g.) being in the presence of oats. There seems to be no detectable quantities of

this antibiotic in soil with any of the other amendments tried except for traces on the 14th day in stubble amendment. In both oat and green leaf amended soils there was a drift to the acid side from the original pH of 8·1.

Unlike *Aspergillus terreus*, *A. clavatus* and *Penicillium patulum* which were shown by Grossbard[3] to produce antibiotics in soils supplemented with glucose alone, *F. vasinfectum*, as evident from these results, requires ample source of both organic nitrogen and carbohydrate for the production of fusaric acid in soil. In fact, it is worthwhile to note that *P. patulum* produced decreasing quantities of antibiotic with increasing concentration of nitrogen.[3]

The significance of the production of this antibiotic by *F. vasinfectum* in sterilised soil amended with rich source of organic food, especially in the light of increasing knowledge of microbial activity in the rhizosphere[7,8] has been discussed elsewhere.[9]

The author is thankful to Prof. T. S. Sadasivan and Dr. C. V. Subramanian for valuable suggestions in the preparation of this paper and the Government of India for the award of a Fellowship.

University Botany Lab., R. KALYANASUNDARAM
Madras-5, *June* 23, 1955.

1. Grossbard, E., *Nature*, Lond., **1948**, **161**, 614.
2. Brian, P. W., Wright, J. M., Stubbs, J. and Way, M., *Ibid.*, 1951, **167**, 347.
3. Grossbard, E., *J. Gen. Microbiol.*, 1952, **6**, 295.
4. Wright, J. M., *Nature*, Lond., 1952, **170**, 673.
5. Gäumann. E., Naef-Roth, S. and Kobel, H., *Phytopath. Z.*, 1952, **20**, 1.
6. Kalyanasundaram, R., *J. Indian bot. Soc.*, 1955, **34**, 43.
7. Agnihothrudu, V., *Doctoral Thesis, Univ. of Madras*, 1954.
8. Katznelson, H., Rouatt, J. W. and Payne, T. M. B. *Nature*, 1954, **174**, 1110.
9. Kalyanasundaram, R., *Proc. Indian Acad. Sci.*, 1955, **41B**, 117.

## OBSERVATIONS ON NUCLEAR PHENOMENON OF SPORE-GERMINATION IN THE MYCELIA OF *POLYSTICTUS SANGUINEUS* (L.) MEY.

AN investigation into the nuclear conditions in the mature spores of *Polystictus sanguineus* (L.) Mey. before and after germination and also in the monocaryotic as well as dicaryotic mycelia has been made. This has been done from total preparations of spore-deposits and cultures upon thin films of agar on slides prepared according to Kniep's method as modified by Sass.[1]

The observations show that the mature spores are always uninucleate (Fig. 1, *a*). When

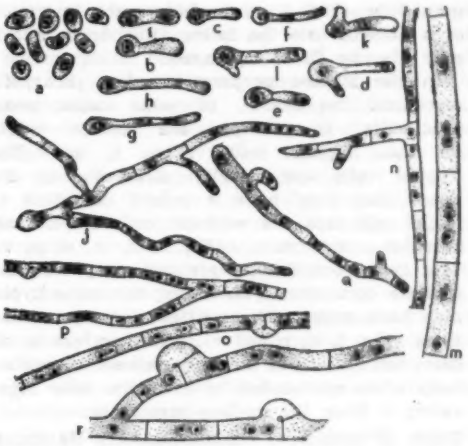



FIG. 1. Nuclear Phenomenon of Spore-Germination in the Mycelia of *Polystictus sanguineus* (×685).

germination starts a short germ-tube is produced (Fig. 1, *b* and *c*). This is followed by the division of the spore-nucleus. One of the two daughter nuclei thus produced then migrates into the germ-tube while its sister nucleus remains within the spore-case (Fig. 1, *i*). As the germ-tube elongates a transverse septum develops usually towards its base close to the point of its emergence from the spore-case (Fig. 1, *e*). This septum-formation may sometimes be postponed until the nucleus within the spore-case has divided further (Fig. 1, *f* and *g*). The aseptate germ-tube, in such cases, may attain a length of 20 $\mu$ (Fig. 1, *g*). The resulting primary mycelium has most of its constituent cells multinucleate, each with 2-6 nuclei (Fig. 1, *j*). In preparations of monocaryotic mycelia obtained from cultures similar coenocytic conditions have also been found in certain cells (Fig. 1, *n*). It is, therefore, evident that nuclear divisions are not always followed in regular sequence by the division of the cells by the formation of septa. In some cases two successive germ-tubes are produced from different places of the spore-wall, but the second one generally develops almost at right angle to the first (Fig. 1, *k*). In such cases the second germ-tube makes its appearance only after one of the daughter nuclei of the spore has migrated into the first germ-tube (Fig. 1, *k*). The remaining daughter nucleus within the spore-case then divides and one of these daughter nuclei passes into the second

germ-tube (Fig. 1, *d*). The formation of a septum at the base of the first germ-tube usually occurs before the development of the second germ-tube (Fig. 1, *e*) or before the migration of a nucleus into the latter (Fig. 1, *l*), but it may also be further delayed.

In the stained preparation of a dicaryotic mycelium the nuclei, in some cases, seem practically to occupy the entire width of the hyphal cells (Fig. 1, *p*). The hyphal cells are usually dicaryotic in the sense that they have a paired condition of nuclei, although 3-4 nucleate cells are not altogether uncommon (Fig. 1, *l*, *m*, *o*, *p*, *r*). The clamp-connections are not very frequent in their occurrence. Therefore, the same hypha may have septa with or without clamp-connections (Fig. 1, *o*, *p* and *r*). The nucleus in all cases can be seen as a deeply stained chromatin-body often surrounded by a hyaline zone separating it from the nuclear membrane.

Dept. of Botany, SACHINDRANATH BANERJEE.
Calcutta University, ASOKE KUMAR SINHA.
Calcutta-19,
*March* 29, 1955.

1. Sass, J. E., *Amer. J. Bot.*, 1929, **16**, 661.

## A NEW *PHYLLACTINIA* FROM MADHYA BHARAT

WHILE on a visit to Sukhanand Temple which lies 5 miles north of the Town of Jawad (24° 36′ N., and 74° 52′ E.) in the Mandsaur District of Madhya Bharat, the writer collected a *Phyllactinia* in cleistothecial stage on the fallen leaves of *Cordia dichotoma* Forst. In establishing it as a new species the author is closely following the treatment of the genus as advocated by Blumer,[1] Linder,[2] and Doidge.[3]

In Table I the present species has been compared with others possessing larger cleistothecia. The dimensions of cleistothecia, asci, and ascospores of *P. salmoni* Blumer, *P. hippophäes* Thuem., *P. robonis* (Gachet.) Blumer, *P. suffulta* (Rebent.) Sacc., and *P. elægni* Linder are taken from Linder,[2] while those of *P. combreti* Doidge from Doidge.[3] It is a pleasure to dedicate this species to Dr. M. J. Thirumalachar whose contributions to Systematic Mycology in India are so vast and varied.

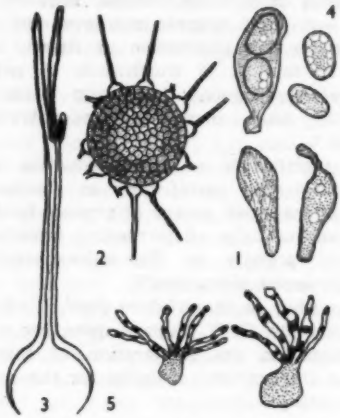



FIG. 1. Two conidia, one germinating at its apex, × 253. FIG. 2. A cleistothecium in surface view, × 60. FIG. 3. An appendage proliferating into four branches (one darkened in the figure), × 327. FIG. 4. An ascus and two released ascospores, × 208. FIG. 5. Two separated penicillate cells, × 327.

*Phyllactinia thirumalachari* Payak spec. nov.

*Mycelium* hypophyllum, operiens totam laminam, persistens, pallide album. *Conidia* (Fig. 1) acrogena, solitaria, rhomboidea vel lanceolata vel subclavata, hyalina, irregulariter atque dense verrucosa, 49·4-83·6 × 15·2-26·6 μ. *Cleistothecia* (Fig. 2) hypophylla numerosa, dispersa, raro gregaria, brunneo-nigra, sphærica, 190-342 μ diam. *Appendices* (Fig. 3) 20-25 in

TABLE I

| Species | Cleistothecia | | Asci | | Ascospores |
|---|---|---|---|---|---|
| | No. of appendages | Diameter in microns | No. of Asci | Size in microns | Size in microns |
| *P. salmoni* | 10–30 | 294–362 | 20–30 | 80–110×30–50 | 35–45×20 |
| *P. hippophäes* | Many | 246–275 | 25–40 | 70– 80×25–40 | 20–35×15–20 |
| *P. robonis* | 15–30 | 214–250 | 15–30 | 70– 90×25–35 | 30–40×19–23 |
| *P. suffulta* | 6–12 | 160–230 | 10–30 | 70–100×25–50 | 25–40×15–25 |
| *P. elægni* | 8–13 | 247–303 | 30–35 | 97–110×34–42 | 38–47×19–23 |
| *P. combreti* | 15–20 | 275–400 | 40–50 | 80– 95×27·5–37·5 | 35–40×17·5–25 |
| *P. thirumalachari* | 20–25 | 190–342 | 25–35 | 68– 95×27–34 | 23–42×17–23 |

singulis cleistotheciis, æquatoriales, bulbosæ ad basim, fastigatæ vel rotundatæ ad apicem, centro hyalino, rigidæ, nonnumquam binæ ex unica basi, vel proliferantes in duos tresve ramos prope apicem, breviores diametro cleistothecii vel ei æquales, 220-342 μ longæ. *Asci* (Fig. 4) 25-35 un singulis cleistotheciis, luteo-aurantiaci, subcylindrici vel late clavati, acute desinentes in uncum vel paxillum ad basim, nonnumquam apicilater crassi, magnit. 68-95 × 27-34 μ. *Ascosporæ* (Fig. 4) ovato-ellipticæ vel angulariter globoideæ ob mutuam pressionem, aurantiacæ, parietibus lævibus, binæ vel quaternæ in singulis ascis, magnit. 23-42 × 15-23 μ. *Cellulæ Penicillatæ* (Fig. 5) plurimæ, bene evolutæ, *plus* minusve persistentes.

Habitat in foliis deciduis *Cordiæ dichotomæ* Forst. in loco Sukhanand, proper Jawad, in Distr. Mandsaur, in Statu Madhya Bharat, die 5 martii, 1953; typus lectus a M. M. Payak.

The type is being deposited in the Herb. Crypt. Indiæ Orient., New Delhi, Herbarium of the Commonwealth Mycological Institute, Kew, U.S. National Fungus Collection, and Farlow Herbarium of the Harvard University.

I am indebted to Dr. S. P. Agharkar for his interest and encouragement, to Rev. Father H. Santapau, S.J., for furnishing the Latin diagnosis and finally to Dr. M. J. Thirumalachar for his invaluable help and advice.

Botany Lab., M. M. Payak.*
MACS, Law College Building,
Poona, *June* 7, 1955.

* Junior Research Fellow of the National Institute of Sciences of India.

1. Blumer, S., *Beitr. Kryptog. Fl. Schweiz.*, 1933, **7**, 378 (original not seen).
2. Linder, D. H., *Mycologia*, 1943, **35**, 467.
3. Doidge, E. M., *Bothalia*, 1948, **4**, 841.

## OCCURRENCE OF *SERRATIA MARCESCENS* BIZIO ON CUTWORM FROM INDIA

The "prodigious" or "miraculous" bacterium *Serratia marcescens* Bizio (Syn. *Chromobacterium prodigiosum* Topley and Wilson, *Bacterium prodigiosum* Lehmann and Neumann) has not yet been reported to occur in India. In the course of investigations on control of insects by microbiological methods, a bacterium was isolated from *Agrotis Ypsilon* (cutworm insect commonly occurring in West Bengal on cabbage, potato, cauliflower, etc.). The pure culture of the bacterium was made on nutrient agar and it was identified as *Serratia marcescens* Bizio. As the bacterium is being reported for the first time in India and as considerable variation exists in the species a short description of the organism isolated is given below:

*Morphological Characters.*—Single to chained cells, spherical, measuring 0·4 to 0·8 μ rigid, polymorphism reported by Reed[1] was not noted. The organism is gram negative, motile with peritrichous flagella, non-capsulated, non-spore-forming, aerobic to facultative. The organism is usually deep red in colour due to presence of a pigment prodigiosin.[2]

*Cultural Characteristics.*—On nutrient agar, colonies are mostly smooth (99% smooth, 1% rugose), circular, raised, entire, undulate to lobate, red to shiny pink. Pigmentation starts at the very initiation of growth and within 24 hours the colonies have the characteristic red to shiny pink colour. On plating out, the red colonies usually give rise to a few white colonies. The white ones tend to remain white in subsequent generations.

On nutrient agar slants, 24 hr.-old culture shows moderately heavy growth. Growth is smooth, with moist layer, filiform with tendency to become echinulate.

In nutrient broth, 48 hr. growth shows the presence of red ring with deposition of red sediment. Pellicle formation is absent. Motility is noticed in young as well as one week-old culture.

The organism fails to grow on a medium containing 1% glucose, 0·2% sodium nitrate, 0·5% potassium dihydrogen phosphate and 0·2% magnesium sulphate, but when sodium nitrate is replaced by ammonium salts, moderate growth takes place, but pigmentation is usually lacking.

On sterilized potato cylinders, growth is moderate at the beginning, but within 72 hours it becomes heavy. Pigment formation is intense and the pigment formed is deep red to dark, the potato cylinders however remaining colourless.

*Biochemical Characters.*—Gelatin liquefied within 3-5 days; Litmus milk—acid formation followed by curdling, casein completely digested and pigment formed in the milk; $H_2S$—not liberated; Reduction of nitrate—satisfactory in 2% peptone broth containing $KNO_3$; $NH_3$—formed; Utilisation of carbon sources—acid, but no gas is produced in glucose, lactose, sucrose, mannose and glycerol.

Pigment formation is found to be dependent on presence of organic nitrogen in the medium and suitable temperature and takes place between 24° C. and 36° C., the optimum temperature being 28-30° C. The pigment sometimes,

in the initial stages, is light in colour but becomes deep with age. In this case it was found to be soluble in water, alcohol and benzol. Bergey[3] reports that the pigment is soluble in water in cases of deeply pigmented strains.

It may be pointed out that Dixit and Vacha[4] reported a few years back a species of *Serratia Sambharianus* from Sambhar Lake, India, which is entirely different from *Serratia marcescens* Bizio.

State Agric. Res. Inst., Calcutta-40, *July* 1, 1955. S. B. CHATTOPADHYAY. KRISHNA MUKHERJEE.

1. Reed, G. B., *Journ. Bact.*, 1937, **34**, 255.
2. Porter, J. R., *Bacterial Chemistry and Physiology*, 1950, John Wiley & Sons, 423.
3. Bergey's Manual of Determinative Bacteriology, 1950, 6th edition, 479.
4. Dixit, S. C. and Vachha, S. B., *Curr. Sci.*, 1942, **21**, 107.

## INHERITANCE OF WAXY BLOOM IN WHEAT PLANTS

ONE of the items of plant breeding work undertaken at the Agricultural Research Station at Bijapur in the Bombay State is the hybridization of high yielding selections in the local durum wheats with the Canadian rust-resistant type 'Gaza'. The selections, which mature in about 96 days as against the 118 days required by 'Gaza' under Bijapur conditions, develop bloom on their stem and leaves in about the fifth week, 'Gaza' being wax-free.

Wax-efflorescence has been studied by several workers who have found it either dominant or recessive.[1-3]

Two crosses were made by the authors in 1949-50, and the results obtained are reported here. In both crosses the $F_1$ plants were found to be wax-free. The wax-less and waxed individuals in the $F_2$ generation were 191 and 63 respectively in the cross Gaza × 485-56 Red Hard, and 77 and 31 in Gaza × 39-1 Yellow-grained. In both cases the fit to the 3 : 1 ratio of monogenic inheritance was very good, the $X^2$ being 0·005 and 0·790 respectively with P values between 0·95 and 0·50 in the first case, and between 0·50 and 0·20 in the second case.

The seed of the $F_2$ individuals was sown to raise the third generation of the crosses with a view to separate out the segregating and non-segregating progenies. The data are presented in Table I.

TABLE I

| Name of the Cross | No. of $F_3$ progenies with wax-less plants only | No. of $F_3$ progenies segregating for wax-less and waxed plants in a monogenic manner | No. of $F_3$ progenies having waxed plants only | Total No. of progenies studied in $F_3$ generation |
|---|---|---|---|---|
| Gaza × No. 485–56 | 59 | 122 | 47 | 228 |
| Expected on a 1 : 2 : 1 basis | 57 | 114 | 57 | 228 |
| | $\chi^2$–2·39; P between 0·50–0·20 | | | |
| Gaza × No. 39–1 | 19 | 55 | 34 | 108 |
| Expected on a 1 : 2 : 1 basis | 27 | 54 | 27 | 108 |
| | $\chi^2$–4·2; P between 0·20–0·10 | | | |

The 59 : 122 : 47 and the 19 : 55 : 34 ratios of the progenies of the first and second cross respectively are comparable to the behaviour expected of an $F_3$ segregation. Examination of a still larger number of progenies would perhaps give a better estimate of the homozygous classes in the $F_3$ generation as, for instance, the progenies of the two crosses added together indicate a 78 : 177 : 81 ratio fitting closely to the expected one, *viz.*, 84 : 168 : 84 for the three classes of frequencies ($X^2$—1·02; P—0·99).

The waxy bloom as studied in the durum crosses is therefore recessive to the wax-free plants, the two characters being governed by a single factor pair.

Agric. Res. Station, Bijapur, *February* 12, 1955. V. M. CHAVAN. G. P. ARGIKAR. P. S. HATTIANGADI. M. S. SALANKI.

1. Matsuura, H. A., *Bibl. Monogr. on Genetics*, 1900-1925, 274.
2. Anonymous, *J. Amer. Soc. Agron.*, 1946, **38**, 1089.
3. Vavilov, N. I., *Chron. Bot.*, 1949-50, **13**, 1/6, 211.

## EFFECT OF S/Se AND Ca/B RATIOS ON GROWTH AND SAP CHARACTERISTICS OF SUGARCANE

AN attempt is made in this note to illustrate the possible variation in growth and sap characteristics of sugarcane (var. Co. 453) when grown under varying ratios of S/Se and Ca/B in local sandy loam soils. Different ratios under study were: (i) S/Se—10 : 10; 9 : 6; 15 : 5; 15 : 2·5 and 12 : 1; and (ii) Ca/B—10 : 2·5; 20 : 2; 30 : 1·5; 40 : 1; and 50 : 0·5. Quantity supplied was expressed in p.p.m. of soil.

A basal nutrition of 80 p.p.m. N, 40 p.p.m. $P_2O_5$ and 20 p.p.m. $K_2O$ was also supplied as sulphate of ammonia, superphosphate and sul-

phate of potash. Treatments were replicated four times. Analysis of growth and sap characters was done in the manner described earlier.[1]

S/Se ratios showed significant responses on various sap characteristics. A ratio of 3 : 1 appeared desirable for leaf weight, yield and height. Higher ratio of 12 : 1 improved root weight and leaf number. A ratio of 3 : 1 raised density and osmotic pressure of the stem sap. Osmotic pressure, solute concentration and electrical potential of leaf sap were also improved. A higher ratio of 6 : 1 induced marked improvement in surface tension, specific electrical conductivity and pH of stem sap. A ratio of 12 : 1 raised viscosity of the stem sap besides improving density, surface tension, viscosity and pH of the leaf sap. Harmful effect of Se on yield was overcome by supplying in a S/Se ratio of 3 : 1 while higher doses of sulphur in the ratio of 6 : 1 or 12 : 1 improved physico-chemical properties of the sugarcane sap. Such improvements in growth were also recorded in these and other species of plants[3,4] under certain specific ratios of these elements.

TABLE I

*Optimum ratios of S/Se and Ca/B for various growth and sap characteristics of sugarcane*

| Characters | Stem Optimum S/Se ratio | Leaf Optimum S/Se ratio | Stem Optimum Ca/B ratio | Leaf Optimum Ca/B ratio |
|---|---|---|---|---|
| **A. Growth Characters** | | | | |
| Shoot number .. | 3·0 | | 100·0 | |
| Leaf number .. | 12·0 | | 4·0 | |
| Shoot height (cm.) .. | 3·0 | | 20·0 | |
| Leaf weight (g.) .. | 1·5 | | 4·0 | |
| Trash weight (g.) .. | 6·0 | | 20·0 | |
| Root weight (g.) .. | 12·0 | | 20·0 | |
| Cane weight (g.) .. | 3·0 | | 20·0 | |
| **B. Physico-chemical Properties of Sap** | | | | |
| Density | 3·0 | 12·0 | 100·0 | 10·0 |
| Surface tension | 6·0 | 12·0 | 4·0 | 20·0 |
| Viscosity | 12·0 | 1·0 | 4·0 | 100·0 |
| Osmotic pressure | 3·0 | 3·0 | 100·0 | 4·0 |
| Solute concentration | 1·0 | 3·0 | 4·0 | 10·0 |
| Electrical resistance | 1·5 | 12·0 | 4·0 | 40·0 |
| Sp. electrical conductivity | 6·0 | 1·0 | 100·0 | 10·0 |
| pH | 6·0 | 12·0 | 10·0 | 20·0 |
| Electrical potential | 1·5 | 3·0 | 4·0 | 4·0 |

Taking height, trash, root and cane weight into consideration a Ca/B ratio of 20 : 1 appeared most desirable. A lower ratio of 4 : 1 appeared favourable for leaf number and weight, while tillering was maximum under 100 : 1 ratio. Surface tension, viscosity, solute concentration, electrical resistance and electrical potential of leaf sap were improved under Ca/B ratio of 4 : 1. A higher ratio of 10 : 1 appeared desirable for maintaining high pH. Even 100 : 1 ratio appeared favourable for density, osmotic pressure and specific electrical conductivity of stem sap.

On leaf sap a Ca/B ratio of 4 : 1 again improved osmotic pressure and electrical potential, while density, solute concentration and specific electrical conductivity were higher under 10 : 1 ratio. A ratio of 20 : 1 improved surface tension and pH, while 100 : 1 raised the viscosity of the leaf sap (Table I). Calcium was, therefore, invariably needed in higher proportion than boron for improving growth and sap characteristics. Similar helpful effects were recorded by McMurtray[5] and Martin.[6] A detailed discussion of these results appears elsewhere.[2]

Plant Physiol. Lab., College of Agric., Banaras Hindu University, Banaras-5, *June* 6, 1955.

K. N. LAL.
J. N. TANDON.

1. Lal, K. N. and Tandon, J. N., "Symposium on trace elements", *Proc. Nat. Inst. Sci. Ind.*, 1955 (in press).
2. — and Rao, M. S. S., *Microelement Nutrition of Plants*, B.H.U. Press, 1954.
3. Brenchley, W. E., *Bot. Rev.*, 1936, **2**, 173.
4. HurdKarrer, A. M., *J. Agric. Res.*, 1934, **49**, 343.
5. McMurtray, J. E., *Bot. Rev.*, 1938, **4**, 183.
6. Martin, A. L., *Amer. J. Bot.*, 1937, **24**, 198.

## A TECHNIQUE OF WHOLE MOUNTS FOR THE STUDY OF FLORAL ANATOMY

THE present note describes an easy and quick method of whole mounts for the study of floral anatomy.

Young flowers, fixed in F.A.A., or in killing fluids containing chromic acid[2] for at least 24 hrs. and washed with water, are treated with 10% KOH sol. in distilled water for 12 to 24 hrs.; or, to hasten the process, they may be boiled for 5 minutes. The material, which becomes somewhat transparent after the treatment, should be selected. Old fixed materials and also those that contain abundance of tannin become black with this treatment. In such cases, fresh material should be taken and it should be treated to remove the tannin.[3] Small flowers are cleared in KOH before being stained and dissected under the binocular, but for bigger flowers, the floral parts are separated

before the treatment. The ovary of bigger flowers may be cut into two halves, if convenient. When the material becomes transparent to some extent, it is washed thoroughly with distilled water and stained with basic fuschin prepared after de Tomasi,[1] but no hydrolysis of the material with 1/N HCl is, however, needed. When the material takes a deep red stain (after nearly 1 to 2 hrs.), it is removed and washed thoroughly with tap-water. The stained material is then transferred to lactophenol for 2 to 4 hrs., which removes the excess of stain and also makes the material perfectly transparent. Only the lignified parts retain the stain while the whole material becomes destained and soft. Such stained materails, mounted on a slide in glycerine jelly, are studied directly under a microscope. Nevertheless, this technique may conveniently be applied for the study of thickenings of the xylem elements, the endothecium of anthers, and to some extent, the transmitting strand of the style, the calyx segments and the corolla parts. Figs. 1,

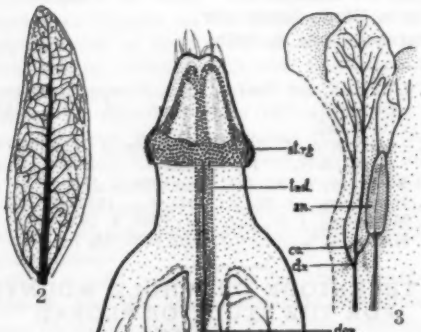



FIG. 1. Whole mount of ovary of *Heliotropium indicum L.*, *ctr.* = corolla trace; *dor.* = dorsal trace; *fl. dk.* = floral disc; *ktr.* = calyx trace; *lat.* = lateral trace; *ov.* = ovule; *st.rg.* = stigmatic ring. *tr. st.* = transmitting strand; *vent.* = ventral trace, × 15.

FIG. 2. Whole mount of calyx segment showing closed venation. *H. indicum* L., × 4.

FIG. 3. Whole mount of a portion of corolla; *an.* = anther, *co.* = corona, × 4.

2 and 3 have been drawn from the whole mounts of the flower of *Heliotropium indicum* L., a detailed account of the floral anatomy of which will be found elsewhere.[4]

The author is grateful to Dr. Bahadur Singh, Dr. R. K. Singh and Ch. Shiva Singh for guidance, facilities and encouragement.

Dept. of Botany, RAMJI SHARMA.
J. V. College, Baraut,
Meerut, *March* 20, 1955.

1. De Tomasi, J. A., *Stain Tech.*, 1936, **4**, 137.
2. Hillary, B. B., *Bot. Gaz.*, 1939, **101**, 276.
3. Johansen, D. A., *Plant Microtechnique*, 1940, Mc-Graw-Hill.
4. Sharma, R. J., *Agra Univ. J. Res.* (*Sci.*), 1954, **3**, 118.

## USE OF SYNTHETIC HORMONE TO STEP UP SUGAR IN CANE

FOLIAR spray of 2, 4-dichlorophenoxyacetic acid at very low concentrations was reported by Beauchamp[1–3] to increase sucrose content of cane. Subsequent workers, however, failed to get consistent statistically significant results.[4–7] As all the work referred to above consisted of laboratory juice analyses on representative cane samples drawn from small experimental plots (necessarily entailing a certain amount of sampling error) and did not take into consideration actually determined values of sugar in cane (which could be calculated only roughly from juice analysis results), it was considered necessary to carry out large-scale tests under actual manufacturing conditions to settle the issue conclusively. For this purpose, trials were arranged with three varieties of cane (each at a different place), the treatment involved being a spray of 2, 4-dichlorophenoxyacetic acid (sodium salt) at a concentration of 50 p.p.m. applied at 60 gallons per acre. Large blocks of 8-10 acres under the same variety were used in the experiments, alternate strips of about an acre in size (separated by 15′ buffers on either side) being used as treated and control plots. The entire crop in treated and control plots was harvested at the same time and subjected to mill tests at the factory.

It will be seen from Table I that the spray treatment brings about increases in sugar recovery varying between 0·33 and 0·80 unit in all the six tests carried out, the effect being noticeable as early as 2 days after spraying and remaining unimpaired after a lapse of 31 days. It is also noteworthy that the treatment proves effective even when applied at a stage not much earlier than the peak maturity phase, as evident from the high purity of mixed juice recorded in controls 2 days after the date of

TABLE I

| Particulars | I Majhaulia (Nawtan Farm) Variety : B.O. 10 Spray : 28th January Harvest : 30th ,, (Interval : 2 days) | | II Majhaulia (Nawtan Farm) Variety : B.O. 10 Spray : 30th January Harvest : 26th February (Interval : 27 days) | | III Majhaulia (Dumri Farm) Variety : B.O. 17 Spray : 29th January Harvest : 31st January (Interval : 2 days) | |
|---|---|---|---|---|---|---|
| | Treated | Control | Treated | Control | Treated | Control |
| Sugar % cane .. | 14·08 | 13·75 | 14·39 | 13·85 | 14·12 | 13·52 |
| Fibre % cane .. | 16·78 | 17·16 | 18·05 | 18·85 | 16·62 | 17·20 |
| Mixed juice purity .. | 89·54 | 88·64 | 88·81 | 87·22 | 85·79 | 84·25 |
| Estimated recovery .. | 11·88 | 11·55 | 12·15 | 11·55 | 11·80 | 11·25 |
| Improvement in estimated recovery | 0·33 | .. | 0·60 | .. | 0·55 | .. |

| Particulars | IV Majhaulia (Dumri Farm) Variety : B.O. 17 Spray : 31st January Harvest : 28th February (Interval : 28 days) | | V Majhaulia (Dumri Farm) Variety : B.O. 17 Spray : 31st January Harvest : 3rd March (Interval : 31 days) | | VI Hassanpur (Chakthat Farm) Variety : B.O. 11 Spray : 17th February Harvest : 19th February (Interval : 2 days) | |
|---|---|---|---|---|---|---|
| | Treated | Control | Treated | Control | Treated | Control |
| Sugar % cane .. | 13·62 | 13·28 | 14·36 | 13·60 | 14·07 | 13·43 |
| Fibre % cane .. | 18·85 | 19·22 | 19·55 | 20·45 | 17·62 | 14·19 |
| Mixed juice purity .. | 83·26 | 82·52 | 84·46 | 83·74 | 87·48 | 85·07 |
| Estimated recovery .. | 11·40 | 11·03 | 12·00 | 11·20 | 11·74 | 11·10 |
| Improvement in estimated recovery | 0·37 | .. | 0·80 | .. | 0·64 | .. |

spraying. Statistically, the improvement in sugar recovery is highly significant and the same holds good for sugar per cent. cane and purity of mixed juice. The method therefore holds out great promise for the sugar industry, particularly in view of the insignificant costs involved (6 annas per acre as the cost of hormone and wetting agent used). Arrangements are under way for aerial spraying of the entire reserved areas of all factories in the district of Champaran.

The authors are indebted to the Government of Bihar and the Indian Central Sugarcane Committee for financing the scheme of which the present work forms a part and to M/s. M. P. Sugar Mills, Majhaulia, and New India Sugar Mills, Hassanpur, for extending necessary facilities. The assistance rendered by Sri. R. D. Sahi, Analytical Assistant, during the course of these trials is also acknowledged.

Central Sugarcane Research Station, Pusa, Bihar, *June* 21, 1955.

A. S. CHACRAVARTI.
D. P. SRIVASTAVA.
K. L. KHANNA.

1. Beauchamp, *Sug. J.*, 1950, **13**, 57.
2. —, *Sugar*, 1951, **45** (11), 42.
3. —, *Proc. Assoc. Sug. Tech.*, Cuba, 1952, **24**, 147.
4. De La Vega, *La Ind. Azuc.*, 1952, **58**, 298.
5. Khanna, K. L., *Ann. Rept. Cent. Sugarcane Res. Sta.*, Pusa, Bihar, 1953-54, 127.
6. Mathur, *Proc. 2nd Bien. Con. Sugarcane Res. and Dev. Workers*, India, 1954, Part I, 40.
7. Lakshmikantham and Prasadrao, *Proc. Sug. Tech. Assoc. India*, 23*rd Conv.*, 1954, 100.

## ABILITY OF THE WHITE-FLY TO CARRY MORE THAN ONE VIRUS SIMULTANEOUSLY

THE cotton white-fly (*Bemisia tabaci* Gennad) in India is phytophagus[5,9,10] and has been found to be the vector of a number of virus diseases affecting cultivated crops and weeds in India.[1-6] Experiments were conducted to study the transmission of viruses by white-fly which had acquired two viruses, *viz.*, the yellow vein-mosaic of *bhendi* (Fig. 1) and yellow vein-mosaic of pumpkin (Fig. 2).

The symptoms, host range and virus vector relationships of *bhendi* yellow vein-mosaic have already been published in detail.[7,8] The virus of yellow vein-mosaic of pumpkin is new; therefore, its symptoms, etc., are described here in brief. The virus is not sap transmitted but

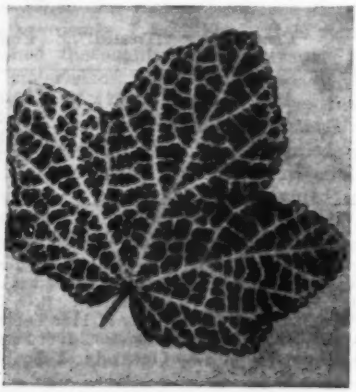


FIG. 1. A *bhendi* leaf showing yellow vein-mosaic.

can be readily transmitted by the white-fly. The disease causes pronounced vein clearing and irregular chlorotic patches on the lamina (Fig. 2). The internodes also become somewhat yellow and the fruits, which do not develop to normal size, have yellow patches on the outside. The yield goes down markedly. This



FIG. 2. A pumpkin leaf showing yellow vein-mosaic.

virus does not infect *bhendi* nor any other plant in Malvaceæ. In addition to pumpkin the virus also infects *Cucurbita pepo* L., and *Cucumis sativus* L. Like the *bhendi* yellow vein-mosaic virus, it has a short incubation period in the white-fly and persists for life in the vector.

White-flies raised in insect-proof glasshouse on healthy cotton plants were first fed for 24 hours on diseased *bhendi*, and then during the next 24 hours on diseased pumpkin plants and *vice versa*. Samples of insects from the two lots were transferred to healthy *bhendi* and pumpkin plants in succession for 9 days allowing them to feed for 24 hours on each host.

Observations indicated that the respective viruses were transmitted to the hosts from which they were acquired by the vector. Similar results were obtained when the feeding period on healthy test plants was reduced to 12 hours.

The results reported here conclusively show that the cotton white-fly is capable of harbouring two different viruses simultaneously and can readily cause infection in healthy host plants susceptible to the respective virus on the same day and can continue to do so for several days without having recourse to the source of infection. Further work with more than two viruses is in progress.

Most of the data recorded so far on the ability of an insect vector to carry more than one persistent virus relates to leaf hoppers.[11-15] The results reported in this paper are the first record of this nature for white-flies.

Grateful thanks are due to Dr. R. S. Vasudeva for guiding the investigation. Thanks are also due to the Indian Council of Agricultural Research for financing the scheme under which the present investigation was carried out.

Division of Mycology & Plant Pathology,
Indian Agric. Res. Inst.,
New Delhi, *April* 23, 1955.

P. M. VARMA.

1. Uppal, B. N., Varma, P. M. and Capoor, S. P., *Curr. Sci.*, 1940, **9**, 227.
2. Varma, P. M., (data unpublished).
3. Capoor, S. P. and Varma, P. M. *Curr. Sci.*, 1950, **19**, 248.
4. —. *Ibid.*, 1948, **17**, 152.
5. Pruthi, H. S. and Samuel, C. K., *Ind. J. Agric. Sci.*, 1939. **9**, 223.
6. Vasudeva, R. S., *Proc. Inter. Microb. Conf. Rome*, 1953.
7. Capoor, S. P. and Varma, P. M., *Ind. J. Agric. Sci.*, 1950, **20**, 217.
8. Varma, P. M., *Ibid.*, 1952, **22**, 75.
9. Hussain, M. A. and Trehan, K. N., *Ibid.*, 1940, **10**, 101.
10. Pruthi, H. S. and Samuel, C. K., *Ibid.*, 1942, **12**, 35.
11. Storey. H. H., *Ann. Appl. Biol.*, 1937, **24**, 87.
12. Kunkel, L. O., *Contrib. Boyce Thompson Inst.*, 1932, **4**, 405.
13. Black, L. M., *American Phil. Soc. Proc.*, 1944, **88**, 132.
14. Giddings, N. J., *Phytopath.*, 1950, **40**, 377.
15. Black, L. M., *Adv. in Virus Res.*, 1953, **1**, 82.

# REVIEWS

**Squaring the Circle and Other Monographs.** By E. W. Hobson and others, Chelsea Publishing. Co., 1953. Pp. 361. Price not given.

This is not one book, but four different booklets reprinted between the same two covers.

The first of them, "Squaring the Circle" by E. W. Hobson published in 1913, covers the first 57 pages and describes the three stages of the history of this famous problem. The first or geometrical period extends from the earliest times to the invention of the calculus in which the approximate determination of $\pi$ was based on the calculation of the sides or areas of regular in- or circumscribed polygons, while in the next stage covering about a century, convergent series, products and continued fractions were called into service. During the last stage which extended up to the late 19th century, attention was centred on the nature of $\pi$ and of $e$, their irrationality, transcendence (non-algebraic character), etc.

The second book, "Ruler and Compasses" by Hilda P. Hudson, Longmans, Green & Co., discusses in its 131 pages the kind of algebraic equations which correspond to geometrical constructions involving the ruler, or compasses or both. There is also a discussion of how to get over the limitations of a small sheet of paper and that of a blunt pencil. It is also shown that any Euclidean construction can be carried out with the use of one circle and the requisite number of straight lines or else the required number of circles and no straight lines at all.

The third book is by Dr. A. N. Singh and was originally published by the Lucknow University Press. In its 110 pages, there is a systematic account of the Theory and Construction of Non-differentiable Functions in four lectures. In the first the author proves the non-existence of the derivative of Weirstrass's function, explains Dini's method of constructing non-differentiable functions, and also considers other functions such as Riemann's, Bolzano's, etc. Geometrical methods of getting curves without tangents and of space-filling curves are then explained, while the last two lectures deal with functions defined arithmetically and with the properties of non-differentiable functions.

The last booklet of 51 pages entitled "How to Draw a Straight Line" is by A. B. Kempe and was originally published by Macmillan & Co., in 1877. It deals with various plane linkages to obtain approximate and exact straight line motion. All the booklets deal with problems of absorbing interest whose appeal does not diminish with the lapse of years.

A. NARASINGA RAO.

---

**Handbook of Ostracod Taxonomy.** By Henry V. Howe. Physical Science Series No. 1. Louisiana State University Press, Baton Rouge, La., U.S.A., 1955. Price $ 5.00.

During the past couple of decades considerable advances have been made in the study of ostracoda as a result of the interest taken by palæontologists engaged in the petroleum industry. Collection of taxonomic information from the resulting large number of publications is no mean task and the debt students of ostracoda owe Dr. Howe for providing this information in a convenient *Handbook* is indeed very great. Compiled by an author who has had the benefit of over 25 years' experience the *Handbook* —the first of its kind on Ostracoda—fulfils a long-felt need.

In the introduction the author indicates the general layout of the *Handbook*. The first part consists of taxonomic terms arranged alphabetically and runs through 197 pages containing nearly 1,200 entries. The second part gives the bibliography (182 pages) and contain references of almost all available ostracod literature published up to the end of 1952. A supplement at the end contains some important additional references published since 1952. The author feels certain that there exists much published literature in the U.S.S.R. and allied countries of which he has no information.

A minor omission in the bibliography is a reference to a paper by Mary H. Latham published in 1938 in the *Proceedings of the Royal Society of Edinburgh*, Vol. 59 (*i*), No. 4, entitled "Some Eocene Ostracoda from North-West India". As the author has himself indicated, such minor omissions are bound to be present in a work of this kind, but these should in no way minimise the usefulness of the *Handbook*.

The author has shown that many recently published generic names are homonyms or

synonyms and the present work should help in considerably reducing the publication of invalid names in future. Ostracod workers all over the world will find the *Handbook* a most useful reference book, and in India where a serious study of fossil ostracoda is yet to be started, this *Handbook* will be found invaluable.

Y. NAGAPPA.

---

**Mathematics for Engineers.** Part I. By W. N. Rose. Ninth Edition. Revised. (Chapman & Hall.) Pp. 528. Price 21 *sh.* net.

The Directly Useful Technical Series attempts to occupy a midway position between technical books which are theoretical and those which are practical. The problems are of a directly useful type and at the same time contain the proper amount of scientific explanation so as to satisfy the enquiring mind. The book, which is one of the above series, was first published in 1918 and has now run into the ninth edition.

Part I treats of the fundamental processes of Algebra, Plane Trigonometry, Mensuration and Graphs in a graded manner. Particular mention must be made of Chapter X, headed 'The Determination of Laws' in which examples from different branches of engineering are taken to explain the method of determining the laws to suit different types of data. The next chapter on the construction of Practical Charts deals with logarithmic plotting and alignment charts and should prove to be of much practical interest.

The treatment of the various topics is lucid and leaves nothing to be desired, and the get-up is good.

K. RAMANUJACHARYA.

---

(*i*) **Electrical Characteristics of Overhead Lines.** By S. Butterworth. (Technical Report Ref. O/T4A.) (Electrical Research Association, England), 1954. Pp. 238.

(*ii*) **Handbook on Electrical Characteristics of Overhead Lines.** (Technical Report O/T4A.) (Electrical Research Association, England), 1953. Pp. 20. Charts 14. Price 15 *sh.*

(i) The volume under review presents in convenient form, the theoretical considerations which decide the electrical characteristics of overhead power lines, and the practical estimation and application of these characteristics.

There are several text-books on overhead line practice to meet the needs of the students. There are also handbooks which cover, besides overhead line data, a wide range of subjects. Further, the tabulations in most of the handbooks do not relate to the British practice. But the book under review contains formulæ relating to the behaviour of the line in very great detail, with the theoretical derivation of all formulæ used, and with sufficient discussion of some refinements. These refinements, though rarely entering the field of practical applications, may have to be studied in any academic or other detailed investigation.

To obtain rapidly and with moderate accuracy those values which frequently occur in British practice, the book presents aids to calculation in the form of alignmest charts by means of which any particular characteristic of a line of given construction can be calculated using only a slide rule.

The book comprises nine chapters. A chapter each is devoted to resistance of transmission lines, inductance, capacitance and susceptance of single phase transmission lines for both stranded and hollow conductors. The fourth chapter deals with the characteristics of three-phase transmission lines with balanced currents and voltages with and without transposition for single circuit lines. Characteristics of double-circuit three-phase untransposed lines are also given in terms of distance between phases so that they may be applied to any arrangement of current in the six conductors. The next chapter deals with the current ratings of overhead lines and gives the current rating formulæ taking into consideration the different factors influencing the rise in temperature of the conductors.

Chapter VI deals with transmission line characteristics under unbalanced conditions. A general theory of unsymmetrical transmission is developed by the method of symmetrical components. Formulæ for impedances are developed for single circuit and double circuit lines with or without earth wires. Conditions obtaining in double circuit system with one circuit earthed are discussed. Effect of multiple earths on sequence impedances and on the magnitude and distribution of earth fault currents are dealt with. Sequence capacitive impedance and surge impedance are discussed, and the scheme of calculation for sequence impedances normally required for single circuit and double circuit systems with or without earth wires is described in detail. The other chapters deal with corona and corona losses, multiple conductor systems, and voltage regulation for short and long lines.

(ii) The *Handbook* summarizes for easy reference those sections of the book by S. Butter-

worth which are most frequently required to aid calculation.

Tables and alignment charts, by means of which the basic electrical constants, current ratings, corona losses and power transmission of overhead lines may be obtained with a minimum of calculation are included. The alignment charts are in a format intended to facilitate their use in the field. Practical examples of calculation for the single-circuit and double-circuit 132 KV lines are given. An illustrative example of calculations for a circuit with multiple conductors is also included.

While both the books are very useful in transmission line engineering, the former will especially be useful to students, teachers and advanced workers in academic work and other investigations.

C. S. GHOSH.

---

**Emulsion Polymerization. By Frank A. Bovery, I. M. Kolthoff, Avrom I. Medalia, Edward J. Meehan. (High Polymers, Vol. IX); (Interscience Publishers, Inc.), 1955. Pp. xii + 445. Price $ 12.5.**

The book is the first of its kind on emulsion polymerization which finds very extensive practical applications such as the production of synthetic rubber in recent times. In this monograph are presented in a very brief and systematic way the interpretation of various aspects with special emphasis on kinetics of emulsion polymerization.

Chapters II and III deal with the various types of free radical initiators in general and especially in emulsion polymerization. Use of modifiers in the production of synthetic rubber is of great importance. Action of chain transfer, reagents, modifiers as they are called, their general kinetic aspects in emulsion polymerization and a lucid account of molecular weight distributions are given. The importance of detergents has been discussed. A complete account of the kinetics of emulsion polymerization as well as inhibition and retardation presented in Chapters VI and VII will prove highly useful for researchers engaged in investigation of high polymers. Copolymerization in emulsion polymerization of a few systems like styrene and acrylonitrile, styrene and methylmethacrylate, styrene and butadiene have been discussed. The chapter on experimental methods in emulsion polymerization in the research laboratory as well in industry will prove very useful for a research chemist in high polymers. A standard G.R.S. recipe discussed in all its aspects gives an overall picture of the nature of emulsion polymerization in industry.

Work on emulsion polymerization especially from the fundamental point of view started just over a decade ago and yet the number of publications on this aspect of high polymers alone are so varied and numerous that it is hardly possible for researchers to follow and to have a unified picture. The monograph under review very ably serves this urgently felt need.

M. SANTHAPPA.

---

**A Symposium on Amino Acid Metabolism. Edited by W. D. McElroy and H. Bentley Glass. (The Johns Hopkins Press, Baltimore), 1955. Pp. xvi + 1048. Price $ 12.50.**

The McCollum-Pratt Institute of Johns Hopkins University has been holding several symposia during the last few years on subjects of major biochemical importance. In one such symposium organised in June 1954, the latest developments in our concepts of metabolism of amino acids, both essential and non-essential were reviewed and discussed by a large number of distinguished scientists all of whom had extensively carried out investigations on different aspects of this subject. The volume under review gives an account of this symposium, of the papers read, and of the discussions which took place after the presentation of the papers together with a lucid summary in the end written by Dr. Bentley Glass.

The amino acids have been arbitrarily divided, for convenience, into several groups and the metabolism of each group presented and discussed by one or more research workers. Thus, after a general consideration of amino acid metabolism by A. Meister, C. B. Thorne, W. W. Umbreit, E. F. Gale and others, the following groups of amino acids have been specially dealt with: (*i*) metabolism of glutamic acid, proline, ornithine, citrulline and arginine, by S. Ratner, M. Stetten and E. L. Oginsky, (*ii*) metabolism of histidine, leucine, isoleucine, valine and lysine, by B. N. Ames, H. Tabor and O. Hayaishi, (*iii*) metabolism of methionine, cysteine and threonine, by J. A. Stekol, T. P. Singer and G. L. Cantoni, (*iv*) metabolism of glycine and serine by S. Weinhouse, W. Sakami and D. Shemin, (*v*) metabolism of aromatic amino acids, by B. D. Davis, D. B. Sprinson, W. E. Knox and C. Yanofsky. In all the papers, exhaustive details of experiments carried out have been given and the conclusions reached by the authors have been critically examined by the

various participants in the course of the discussion. Isotope labelled amino acids and their intermediates have been extensively used in several investigations, and the isolation and study of various enzyme systems involved in amino acid metabolism have geen presented in great detail. The interrelationship of methionine, citrulline and other amino acids, and the relation between tryptophane and niacin synthesis in various organisms have been reported in this volume in a comprehensive manner and future developments in these fields have also been indicated. The summary at the end is extremely useful in that it gives a clear and cogent picture of the whole symposium in a nutshell.

The get-up of the book is excellent, and the volume should prove extremely valuable to all biochemists as well as physiologists who wish to keep themselves posted with the latest developments in this fascinating field of amino acid metabolism.

P. S. SARMA.

---

**The Book of Indian Birds.** Fifth Edition. By Salim Ali. (The Bombay Natural History Society, Bombay), 1955. Pp. vi + 142. Price Rs. 20.

As one who has followed the progress of 'The Book of Indian Birds' from its first publication in 1941, I have no hesitation in acclaiming the latest edition. Mr. Salim Ali has indeed succeeded in producing a book that will stimulate popular interest in our bird life and expertly assist the man-in-the-street in identifying the bird in the bush with certainty, ease and pleasure. The book is slimmer than its predecessors and more 'pocketable'; the old illustrations, which were rather poor, have been replaced completely with new coloured plates, showing four species to the plate; and one notes with pleasure that the original, comprehensive and vivid text has been retained, though slightly abridged.

Much of the credit for transforming what was an useful book into a very attractive and authoritative field-guide should go to the artist, D. V. Cowen. One feels that the reproduction of the plates has not done justice to her work—the yellows in the depictions of the iora and the orioles on Plates 4 and 14, for instance, are muddy, and, in certain plates, the colour lacks colour. I do not think that authentic æsthetic originality can be claimed for all the artist's bird studies; for example, her moorhen at Plate 42 is reminiscent of Roger Tory Peterson, and some of the depictions of common birds, such as the roller on Plate 27 and the hen kœel and Brahminy Kite on Plates 26 and 36, can certainly be improved. But admittedly this is petty criticism of work that is valuable. On Plate 6 the numbers of the Collared Bushchat and Redstart should be interchanged.

A suggestion for the next edition: the common English names of certain Indian birds which had currency till recently, have been wholly left out. Thus, we find *Eremopterix grisea*, so long known by the name 'Ashy-crowned Finch-Lark', now listed only by the new name, the black-bellied Finch-Lark. The former name was unquestionably a poor one and the current one is more descriptive, but for the sake of readers who knew such birds by their now-obsolete names, those names may be listed in an aside without adding to the bulk of the book.

M. KRISHNAN.

---

**Books Received**

*The Physiology of Diapause in Arthropods.* By A. D. Lees. (Cambridge University Press), 1955. Pp. x + 150. Price 12 *sh.* 6 *d.*

*Annals of Applied Biology—Proceedings of the Jubilee Meeting Held in London,* 13-17 Sept. 1954. (Cambridge University Press), 1955. Vol. 42. Pp. ix + 414. Price 25 *sh.*

*Centrifugal and Other Rotodynamic Pumps.* Second Edition. By Herbert Addison. (Chapman & Hall), 1955. Pp. x + 530. Price 50 *sh.*

*High Energy Nuclear Physics (Proceedings of the Fifth Annual Rochester Conference,* Jan. 3-Feb. 2, 1955.) Compiled and Edited by H. P. Noyes, E. M. Hafner, G. Yekutieli and B. J. Raz. (Interscience Publishers, Inc.), 1955. Pp. 197. Price $ 2.50.

*Light Calculations and Measurements—An Introduction to the System of Quantities and Units in Light Technology and to Photometry.* By H. A. E. Keitz. (Philips Technical Library.) (M/s. Philips Electrical Co., India, Ltd., 7, Justice Chandra Mahtab Road, Calcutta-20), 1955. Pp. xvi + 413. Price Rs. 25.

*Cumacea of the Benguela Current.* By N. S. Jones. (*Discovery Reports,* Vol. XXVII, pp. 279-92.) (Cambridge University Press), 1955. Price 6 *sh.* 6 *d.*; *The Wax Plug in the External Auditory Meatus of the Mysticeti.* By P. E. Purves. (*Discovery Reports,* Vol. XXVII, pp. 293-302.) (Cambridge University Press), 1955. Price 10 *sh.* 6 *d.*

*Andhra University Memoirs in Oceanography,* Vol. I. (Andhra University, Waltair), 1954. Pp. iv + 162. Price Rs. 15.

# SCIENCE NOTES AND NEWS

## Ford Prize for Peaceful Uses of Atomic Energy

The establishment by Mr. Henry Ford of a million dollar fund to provide "atoms for peace" awards on a worldwide basis was announced recently. These will be on a worldwide basis, and will be made by an international jury which will each year select an individual or group of individuals to receive a $75,000 award. The award will be made without regard for nationality or political belief, and will constitute a memorial by Mr. Ford and his brothers to their father. If no award was made, the money would be used for scholarships and fellowships to scientists most likely to contribute to the advancement of the new science of the peaceful application of atomic energy.

## *Rauwolfias* for Research

M/s. Rajaranga & Company, Ltd., 5, Thambu Chetty Street, Madras-1, write that they have about 1,000 lb. of *R. beddomei* and 200 lb. of *R. micrantha* for gratuitous distribution to research organizations for investigational purposes, and will be glad to forward samples, on request, on F.O.R. Madras basis.

## International Conference on Nuclear Reactions

An International Conference on Nuclear Reactions is being organised by the "Nederlandse Natuurkun-dige Vereniging" to be held in Amsterdam during July 1-7, 1956.

Among the topics discussed will be: Elastic and inelastic scattering, capture- and photo-reactions, stripping- and pick-up reactions, fission. Further particulars can be obtained from the Conference Committee's Secretary, Dr. S. A. Wouthuysen, Zeeman Laboratorium, Mindergracht 4, Amsterdam (c), Netherlands.

## Gabriella Zuccari Scholarship for Zoological Research

The University Padua is offering a Gabriella Zuccari scholarship of 300,000 lire for research of at least six months duration at the Zoological Station, Naples, during the academic year 1955-56. The scholarship is open to any person who wishes to undertake research in zoology, comparative anatomy, physiology or embryology and it may be renewed up to a maximum of three years. Application forms, to be returned by October 31, and further information can be obtained from the Secretariat of the University of Padua.

## Centenary of Aluminium

The Electrochemical Society, India Section, is planning to celebrate the Centenary of Aluminium during mid-September 1955 in conjunction with other scientific societies in Bangalore. The technical meetings will deal with the present status and the projected future of aluminium industry in India, its use in aircraft, rail and automobile industries, and its role in consumer industries such as cables and conductors, utensils, paints, foils, chemicals and others. The *Bulletin of the Electrochemical Society* intends to bring out a special issue in October wholly devoted to aluminium.

## Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Physics to Shri D. Premaswarup for his thesis entitled, "Some Intensity and Perturbation Calculations in Complex Molecular Spectra and the Structure of the Band Spectrum of Tantalum Oxide", and the D.Sc. Degree in Technology to Shri M. V. Raghavacharya for his thesis entitled, "Vapour Liquid Equilibria of Non-Ideal Solutions".

## A New Type of Plant Growth-Regulating Substances

Van der Kerk and others of the Institute for Organic Chemistry T.N.O. Utrecht, report the plant growth-regulating properties of S-(carboxymethyl)-dimethyl dithiocarbonate, obtained by the reaction of sodium dimethyldithiocarbamate with monochloroacetic acid. They suggest that such an activity in this series of compounds is connected with the possibility of N-C bond acquiring a double bond character as a consequence of similar interval electron shifts. This activity is maintained if one of the hydrogen atoms in the $CH_2$ group is replaced by alkyl group but not when both are replaced. The interesting new feature observed with these compounds seems to be that the electron shifts caused by simple substitutions in the remaining part of the molecule may, or may not, lead to the specific spatial arrangements required for the growth-promoting activity. (*Nature*, 1955, 176, 308.)

**First Congress on Theoretical and Applied Mechanics**

The dates for holding the First Congress on Theoretical and Applied Mechanics have now been fixed as November 1 and 2 (see earlier notice in *Curr. Sci.*, 1955, **24**, 138). Detailed programme along with a printed copy of the abstracts of the papers to be presented before the Congress will be sent to those who register. There will be a few half-hour invited addresses on selected topics. Those who wish to contribute papers are requested to send the abstracts, the registration form and the fee of Rs. 6 before September 30, 1955, to the Organizing Secretary.

It is also proposed to form a National Society for Theoretical and Applied Mechanics, and suggestions regarding its scope and constitution are welcome.

**Fission Physics and Nuclear Theory**

The latest discovered element, mendelevium, has an atomic number of 101. How many more elements will it be possible to discover? According to a prediction by Dr. John A. Wheeler, of Princeton University, Princeton, New Jersey, U.S.A., made in his paper prepared for the United Nations Conference on Peaceful Uses of Atomic Energy, it may be possible to isolate long enough for experimental observation nuclei with a charge of up to 170, compared to uranium's 92 and a mass of 650 (compared to 255 for the latest discovered nucleus).

Such a nucleus would be over twice as heavy as any known nucleus. It would exist perhaps only one ten-thousandth of a second before splitting. Its interest would presumably be purely scientific, not technical. It might be made by very intense and sudden neutron irradiation of uranium.

**Radiosonde on Board Ship**

The possibility of making radiosonde observations on board merchant ships has frequently been discussed and the Commission for Maritime Meteorology has recommended that investigations of the problems involved should be undertaken. Information has been received of a programme being carried out in co-operation between the U.S. Weather Bureau and the Department of the Navy which should provide useful information on this subject. A transport vessel, *General Gaffey*, has been equipped with apparatus for making upper air soundings, and is making observations, for an experimental period of a year, on voyages between San Francisco and Yokosuka, Japan. Finnish radiosondes have been selected for this purpose in view of their light weight and consequent economy in balloons and helium. It is hoped to achieve regularly a ceiling of 300 mb. with 100 g. balloons.

**International Co-operation on Purification of Brackish Water**

In many countries, difficulty is being found in providing the increasing quantities of fresh-water required for domestic and industrial use. For example, sea-water is infiltrating into fresh-water wells in the Thames estuary and it is becoming more and more difficult to suggest other sources that do not involve expensive, long-distance pumping. Talks on the possibilities of various methods of desalting water have been going on for some time under the auspices of O.E.E.C. One promising process is electrodialysis—the removal of salts from a liquid flowing between pairs of ion-selective membranes, by means of an electric field. Research on this method is already well-advanced in the Netherlands. The Dutch recently offered to carry out development work in co-operation with other countries showing an interest. Great Britain has joined the Netherlands, South Africa, Australia and Algeria (representing France) in paying for this work; the problems to be solved are mainly those of bringing up the process from small to large pilot-plant scale.

**Paper from Banana Stems**

The manufacture of paper from abaca (*Musa toztillos*) suggests the possibility of using *Musa sapientum* stem and stems of other varieties of banana for paper manufacture. Like the process evolved for abaca, the banana stem is divided into strips and allowed to dry, in shade, till the moisture content is reduced to 30%. Those are then crushed, extracted and bleached using first a 5% sodium carbonate solution (which can be used 3 or more times) followed with a bleaching powder solution of about 5%. The low yield of the fibre is compensated by the cheapness of the process, the low cost of investment and chemicals, the possibility of pulping the fibres in beaters and the profit from the fruits. Further advantage could be gained by locating the mill in banana plantations.

—*Chemical Age.*

1241-55. Printed at The Bangalore Press, Bangalore City, by C. Vasudeva Rao, Superintendent, and Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.
Editor: Prof. G. N. Ramachandran, A. C. College of Technology, Madras 25

# SUNVIC
# ENERGY REGULATORS

**PRINCIPLE**

Sunvic Energy Regulator effects its control by periodically switching on and off the power.

**ADVANTAGES**

As compared with a variable resistance, the Energy Regulator is cheaper, far less bulky, control is effected without loss of energy, is variable continuously from no load to full load, and is substantially independent of mains voltage fluctuations up to about 20 per cent.

**TYPES**

Panel Mounting Types ERH, ERJ, TYB
Plug-in type ERP
Bench or Wall-mounting type ERC
Energy Regulators with Relays, Types ER-3, ER-6

**APPLICATIONS**

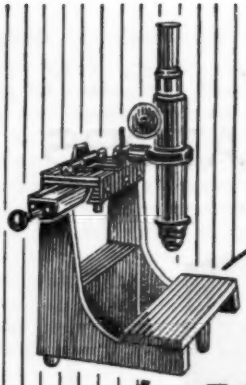
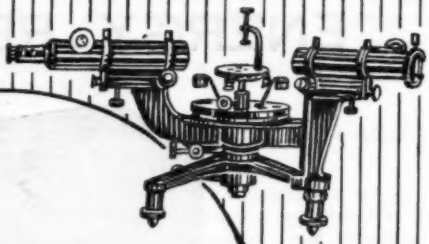
Energy Regulator control is applicable to a wide range of process heating apparatus, such as Hotplates, Moulding Platens, High Temperature Ovens, Furnaces, etc.

*Accredited Agents*

MARTIN & HARRIS LTD.

(Scientific Department)

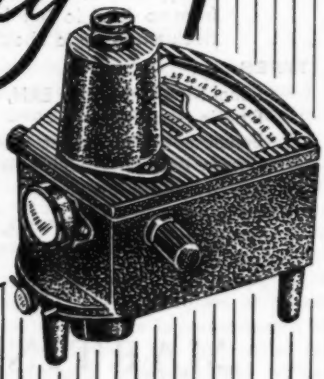
SAVOY CHAMBERS WALLACE STREET BOMBAY 1

# KAYCEE

## SCIENTIFIC INSTRUMENTS

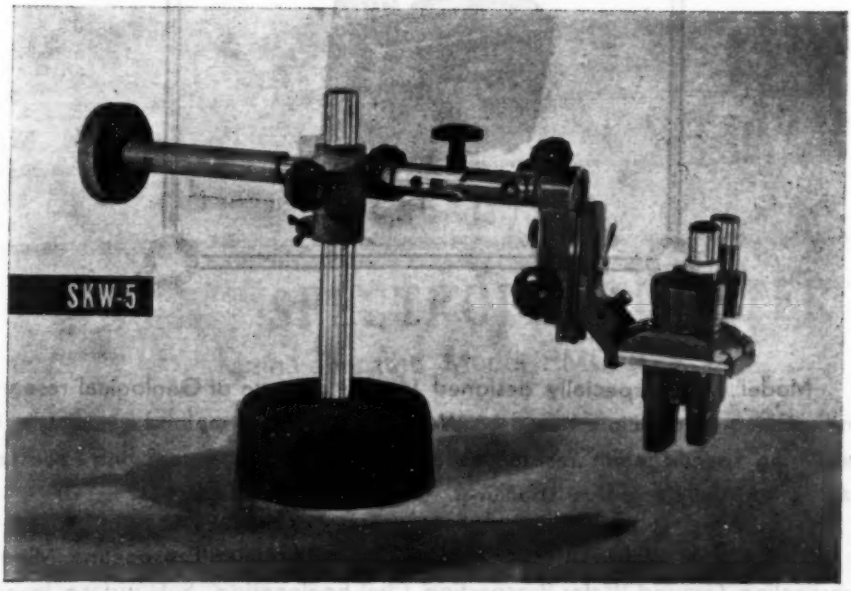
*for Accuracy*



RADIO LAMP WORKS LTD.

BOMBAY • CALCUTTA • DELHI • MADRAS • KANPUR • INDORE

# BAUSCH & LOMB
# STEREOMICROSCOPES
## 3-D
**FOR DEPTH WITHOUT DISTORTION OR DISCOMFORT**




True stereopsis is realized with the advanced design optical systems used in Bausch & Lomb Stereomicroscopes. There are a variety of models, as many as seventeen — to provide simple, convenient operation no matter what the task.

SKW-5 is a typical model which permits vertical, lateral, horizontal and angular stereomicroscope movements.

**Catalogue D-15 on request**

*Sole Agents*

**MARTIN & HARRIS LIMITED**

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

# An Ideal Instrument for Geological Research

## METRAWATT EARTH TESTER

Model JTs is specially designed for the purpose of Geological research and working on principle based on Wenners-four-probe-method is suitable for measuring specific earth resistances at different depths, thus giving necessary data to find out geological structures.

The instrument has special applications in Petroleum-Prospecting, Mineral Prospecting, Ground Water Prospecting, Civil Engineering, Sub-surface Investigations, etc.

*Write for particulars to:*

## THE SCIENTIFIC INSTRUMENT CO., LTD.

**CALCUTTA - ALLAHABAD - NEW DELHI - MADRAS - BOMBAY**